A Phonological Sketch of the Kufo Language

Bachelor of Arts, Honours in Language Studies

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This thesis is submitted in partial fulfilment of the requirements for the degree of Honours in Language Studies in the College of Arts and Social Sciences.

Declaration

I hereby declare that, except where it is otherwise acknowledged in the text, this thesis represents my own original work.

All versions of the submitted thesis (regardless of submission type) are identical.

Sections 2.3, 3.1, 3.2, 3.3, and 5.3 partially draw on material submitted for Assessment 4 in LING4106 Advanced Readings in Linguistics.

The ethics of this project were approved by the Human Research Ethics Committee of the Australian National University (2022/145).

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Abstract

The linguistic diversity of East Africa is well-known, but understandings of the languages in some regions, such as the Nuba Mountains of Sudan, remain extremely limited. There are many open questions regarding the linguistic relationships and genetic affiliation of languages in the Nuba Mountains, and there have been few detailed studies of the many typologically interesting features that these languages exhibit, particularly in their sound systems.

This Honours project aims to develop the first detailed description of the sound system of Kufo, an endangered Kadu language that is traditionally spoken in the Nuba Mountains in south Kordofan, Sudan. The project draws on approaches of experimental phonetics and language documentation to investigate the consonants, vowels, and tones of Kufo, based on speech data collected with one participant, and analysed using qualitative and quantitative methods. This study contributes to crosslinguistic understandings of phonological typology and to the knowledge of the linguistic structure of East African languages. The study also contributes information that informs current community efforts related to language maintenance.

Chapter 1 Introduction

1.1 Overview

Africa is a linguistically diverse region with over a thousand languages, corresponding to many different language families, some of which remain actively debated or uncertain. Kufo (also known as Kufa or Kufa-Lima) is a variety of the Kanga language, which is spoken by approximately 8,000 people in the Nuba Maintains in Sudan and is classified as 'endangered' or 'severely endangered' (Eberhard et al., 2022; UNESCO, 2010). Previous research on Kufo is extremely limited. This thesis aims to produce a detailed description of the sound system of Kufo, based on data collection undertaken with one diasporic speaker of the language.

1.2 Linguistic classification

Beyond Kufo, recognised varieties of the Kanga language are Kursi, Lima, and Shororo. The Kanga language is classified as part of the Kadu language family, as shown below in Figure 1-1 (M. L. Bender, 1997; M. Hall & Hall, 2004). The Kadu languages have also been referred to as Kadugli-Katcha (Dafalla, 2006) or Kadugli-Krongo (M. Hall & Hall, 2004) languages, and the term 'Kadu', which means 'people' in Kufo, is adopted in this study. The term 'Kadu' is discussed by Hall & Hall's (2004) and used by Blench in studies on the Kadu languages and their linguistic affiliation (2006, 2019). Some early studies viewed the Kadu language family as part of the Niger-Congo phylum based on lexical and grammatical evidence (Greenberg, 1966), whereas others argue that the Kadu language family is more closely affiliated with the Nilo-Saharan phylum

(Schadeberg, 1981), which is itself not clearly established as a language family (Güldemann, 2018). Hall & Hall (2004) propose that Kadu is possibly a distinct language family, whereas Blench (2006) suggests that the Kadu languages are similar to Afroasiatic languages in gender marking but resemble Nilo-Saharan languages in case marking and lexicon. More recent work suggests that Kadu has more in common with the languages of the Nilo-Saharan phylum overall (Blench, 2019), though many questions remain. One of the major challenges in research with a focus on linguistic histories and classification is that for most Kadu languages, there is very limited information on their linguistic structures. This is partly due to many decades of conflict in this part of Sudan. The present study extends the understanding of the Kadu languages through undertaking a detailed investigation of the phonetics and phonology of Kufo.

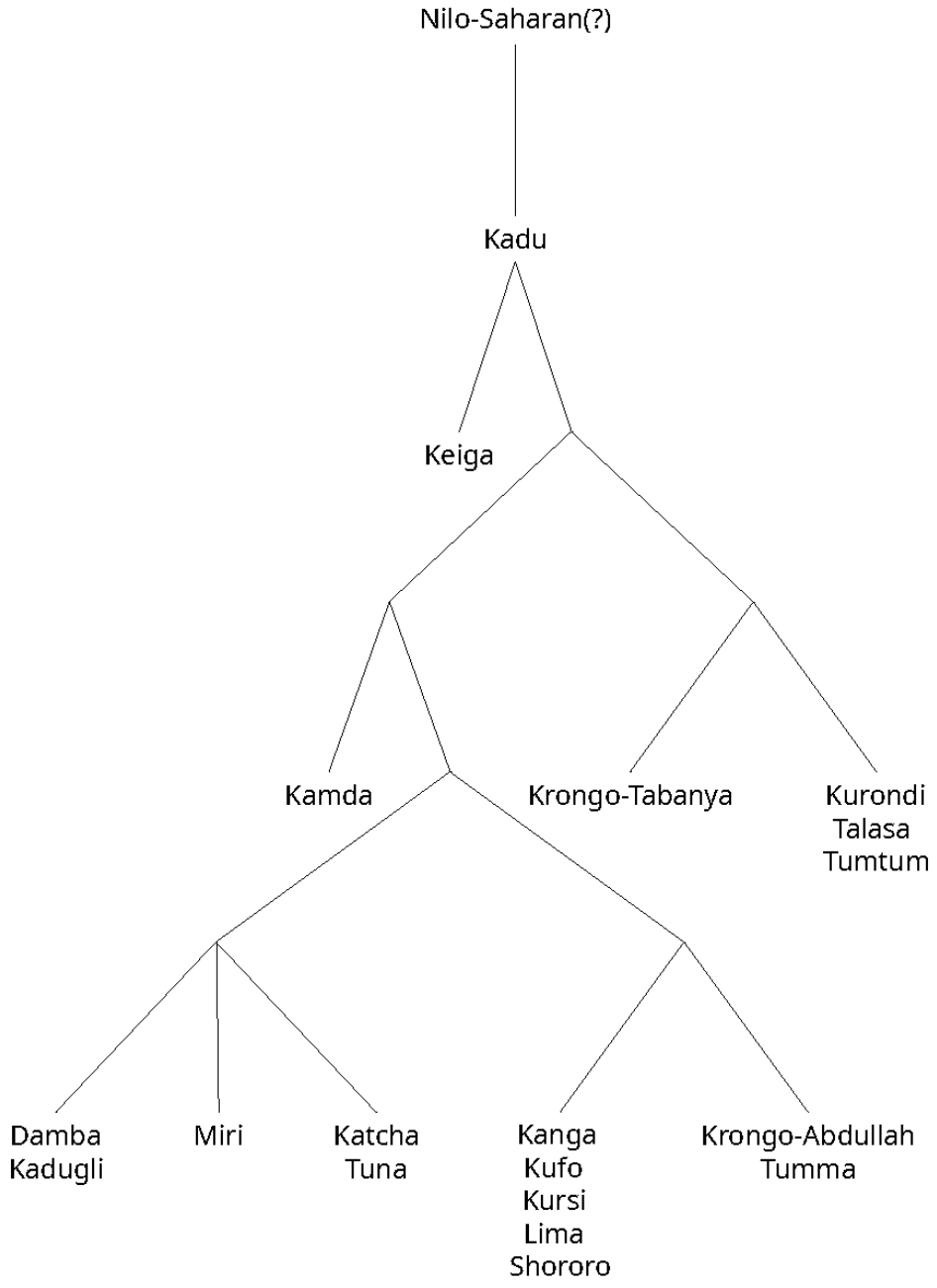

Figure 1-1: Linguistic affiliation of the Kufo variety of the Kanga language.

1.3 Previous work

The current understanding of Kufo phonology is rather limited, mainly based on general phonological comparisons across the Kadu language family, with reference to wordlist data.

For the Kadu language family, Schadeberg (1994) presents comparative Kadu wordlists, based on data collected during fieldwork carried out in the Nuba Mountains from October 1974 to January 1975. Nine languages are documented in the research, including Mudo, Yegang, Kufo, Miri, Talla, Tolibi, Sangali, Krongo, and Talasa, and there are approximately 100 lexical items for Kufo. Based on the wordlists, Schadeberg (1994) proposes a preliminary phonological analysis for the Kadu language family and suggests that the Kadu languages have very similar phonological systems. With a similar approach, Hall & Hall (2004) provide an overview of the Kadu language family based on wordlist data for eight Kadu languages, including Keiga, Kamda, Kadugli, Miri, Katcha, Kanga, Kufo, and Krongo. The Kadu phonemic inventory is presented with both IPA symbols and graphemes which are used in orthography, and examples across the eight Kadu languages are presented throughout the paper to support Hall & Hall's observations on the similarities and differences of the Kadu languages. Other work on the Kadu language family includes a phonological comparison of the Kadu language group by Dafalla (2006), which is based on direct interviews with native speakers, previous phonology descriptions, as well as a wordlist consisting of 179 items written in orthography of nine Kadu languages, including Kanga, Kadugli, Miri, Katcha, Tulishi, Kufo, Shororo/Kursi, Keiga, and Kamda. Though most Kadu languages have not been closely examined, the Krongo

language has received detailed study by Reh (1985). The Krongo language, also referred to as Krongo-Tabanya, is closely related to Kufo, as is shown in Figure 1-1. Reh (1985) presents a description of the Krongo language with a brief discussion of Krongo phonology.

Regarding Kufo, there is a Kufo alphabet book which was developed by two native Kufo speakers, Kafi & Mongash (1998). One of the two authors, Haroun Kafi, is the Kufo speaker participating in the current study. Since the alphabet book does not discuss the specifics of the phonemes and uses orthographic representations instead of IPA symbols, where the Kufo phonemic inventory from this study is discussed, it will be presented with graphemes and informed by further discussion with the first author, Haroun Kafi. The most comprehensive material on Kufo is an unpublished work by Blench and Mongash (2022), which provides a brief discussion of Kufo phonology and morphology accompanied by a wordlist of 699 items collected in 2004.

For many aspects of the sound system of Kufo and the Kadu language family in general, there are unresolved questions. In addition, some of the observed features of the Kufo sound system are of particular typological interest, and crosslinguistically understudied. Existing phonological observations suggest that Kufo has a rich inventory of consonants with various manners and places of articulation, as well as a possible length contrast among consonants (Blench & Mongash, 2022; M. Hall & Hall, 2004). However, the status of some of these consonant distinctions is uncertain, and Kufo may differ from related language varieties in terms of voicing contrasts. There are different views on the number and type of vowel contrasts in previous work, with some proposals for a 7-vowel

system, and other proposals for a 9-vowel or 10-vowel system with an 'Advanced Tongue Root' distinction (Blench & Mongash, 2022; M. Hall & Hall, 2004; Schadeberg, 1994). A possible vowel length contrast has also been suggested. Past studies note that Kufo is a tonal language (Blench & Mongash, 2022; M. Hall & Hall, 2004; Schadeberg, 1994), but there is no systematic analysis regarding the tone inventory or how tones function.

1.4 Motivation, aims, and research questions

This Honours project is undertaken with one speaker of Kufo, who is part of the Sudanese diaspora in Australia, and follows on from data collection as part of the 2021 Field Methods in Linguistics course at the Australian National University (Carroll, 2021; Evans et al., 2021). This study is motivated by the need for more data to inform understandings of typological and genetic relationships within the Kadu language family, and the need to further enrich the understanding of the phonetics and phonology of African languages based on comprehensive studies of more East African languages.

The primary aim of this project is to produce a phonetically-informed description of the phonology of Kufo. Hypotheses about the segmental and tonal inventory of Kufo are developed and examined with acoustic phonetic data. This research project is guided by a series of research questions, beginning with one general question, followed by three more specific questions:

1. What are the major phonological contrasts in Kufo?
2. What are the acoustic correlates of consonant contrasts found in Kufo, particularly in relation to consonant voicing and length?

3. What are the acoustic correlates of vowel contrasts found in Kufo, particularly in relation to possible ‘Advanced Tongue Root’ distinctions and length?

4. What are the acoustic correlates of lexically contrastive tones in Kufo?

Chapter 2 Literature review

2.1 Introduction

As noted in Section 1.3, current descriptive research on Kufo and related language varieties is extremely limited, largely comprising some wordlist materials and preliminary phonological observations. This chapter reviews previous observations relating to the phonology of Kufo and the Kadu languages. Section 2.2 focuses on previous studies relating to Kufo and Kadu consonants, discussing places and manners of articulation, and laryngeal, airstream, and length features. Section 2.3 summarises past findings relating to Kufo and Kadu vowels, including vowel quality, the potential Advanced Tongue Root contrast, and vowel length. Section 2.4 focuses on previous research relating to Kufo and Kadu tones.

2.2 Consonants

2.2.1 Places and manners of articulation

Existing phonological observations relating to Kufo and Kadu consonants include proposals that the consonants exhibit up to six manners of articulation, including plosives, implosives, fricatives, liquids, and glides (Blench & Mongash, 2022; Dafalla, 2006; M. Hall & Hall, 2004; Kafi & Mongash, 1998; Reh, 1985; Schadeberg, 1994). Past studies also suggest that Kufo and related language varieties may have up to nine places of articulation for consonants, including bilabial, labio-dental, dental, alveolar, postalveolar, retroflex, palatal,

velar, and glottal (Blench & Mongash, 2022; Dafalla, 2006; M. Hall & Hall, 2004; Kafi & Mongash, 1998; Reh, 1985; Schadeberg, 1994).

Schadeberg (1994) suggests that the Kadu languages have very similar phonological systems, based on his wordlists of nine Kadu languages. The Kadu consonant inventory proposed by Schadeberg (1994) is presented in Table 2-2-1. Schadeberg (1994) suggest that Kadu consonants occur at six places of articulation, including labial, dental, (post) alveolar, palatal, velar, and glottal, and they appear to have seven manners of articulation, including plosive, implosive, fricative, 'nasal+oral', nasal, liquid, and glide. The Kadu plosives and implosives collectively occur at all six places of articulation, and (post)alveolar is the only place of articulation where there is a contrast between plosive and implosive, the bilabial implosive has no non-implosive counterpart shown. Schadeberg (1994, p. 15) also suggests that the palatal stop occurs in all languages except Kufo. Fricatives occur at labial and (post)alveolar places of articulation, and Schadeberg (1994, p. 16) notes that in Kufo and Sangali, the alveolar fricatives are produced as postalveolar fricatives before /i/, with the only exception being the lexical item 'night' *albɔɔsini*. Nasals occur at four places of articulation, bilabial, alveolar, palatal, and velar. The 'nasal+oral' consonants proposed by Schadeberg (1994) appear to be homorganic sequences of nasals and voiced stops at labial, palatal, and velar places of articulation, whereas the nasals preceding dental and (post)alveolar voiced stops are shown as alveolar. Schadeberg (1994) suggests that consonant sequences apart from these 'nasal+oral' consonants are rare in Kadu languages, and that in almost all Kadu consonant sequences, "one of the two consonants is a liquid or a glide"

(Schadeberg, 1994, p. 18). Both liquids are alveolar, and the two glides occur at labial-velar and palatal places of articulation.

Table 2-2-1: Proposed Kadu consonant inventory (Schadeberg, 1994, p. 14).

	labial	dental	(post) alveolar	palatal	velar	glottal
plosive		d̪	ɖ	j	ɡ	ʔ
implosive	ɓ		ɗ			
nasal+oral	mb	nd̪	nɖ nɗ	ɲj	ŋɡ	
fricative	f		s			
nasal	m		n	ɲ	ŋ	
liquid			l r			
glide				y	w	

Reh (1985) proposes that for Krongo, which as noted in Figure 1.1 of Section 1.1.1 is closely related to Kufo, consonants occur at six places of articulation, including labial, dental/alveolar, retroflex, palatal, velar, and glottal. They have six manners of articulation, including plosive, implosive, fricative, nasal, liquid, and glide. The Krongo consonant inventory is presented in Table 2-2-2. Plosives occur at all six places of articulation whereas implosives occur at bilabial and dental/alveolar only. The voiced plosives are classified as implosives regarding the manner of articulation, and they appear to have the implosive phones as their allophones, but the environment in which the allophones occur is not specified. Nasals appear at four places or articulation, including bilabial, alveolar, palatal, and velar. Prenasalisation appears to be possible for all plosives and implosives

except the labial and glottal plosives; notably, the ‘nasal+oral’ consonants which are presented as a standalone manner of articulation by Schadeberg (1994), are presented as contrasts within the plosive and implosive stop series by Reh (1985). In Reh’s (1985) analysis of Krongo, instead of being homorganic as is described by Schadeberg for the Kadu language family (1994), the nasal is always alveolar in ‘nasal+oral’ combinations regardless of the places of articulation of the succeeding plosives, and the nasal component precedes both voiceless and voiced consonants. Fricatives occur at labial, dental/alveolar, and palatal places of articulation. Similar to the description by Schdeberg (1994), the liquids are all alveolar, and the glides occur at labial-velar and palatal places of articulation.

Table 2-2-2: Proposed Krongo consonant inventory (Reh, 1985, pp. 11–12).

	labial	dental/alveolar	retroflex	palatal	velar	glottal
plosive	p pp	t tt	ʈ ʈʈ	c cc	k kk	ʔ
		nt	nʈ	nc	nk	
implosive	b[ɓ] bb	d[ɗ] dd				
	nb	nd				
fricative	f ff	s ss		ʃ		
nasal	m mm	n nn		ɲ ɲɲ	ŋ ŋŋ	
liquid		l ll				
		r rr				
glide	w ww			y yy		

According to the graphemic representations from Kafi & Mongash (1998) and further discussion with the first author who is also the participant of the current sutdy, Kufo consonants seem to occur in nine places of articulation, including

labio-dental, bilabial, dental, alveolar, postalveolar, retroflex, palatal, velar, and glottal, and they have six manner of articulation, including plosive, implosive, nasal, fricative, liquid, and glide. The plosives occur at bilabial, dental, retroflex, palatal, velar, and glottal places of articulation, whereas implosives only occur at bilabial and alveolar places of articulation. Nasals occur at bilabial, alveolar, palatal, and velar places of articulation. Fricatives are found at labio-dental, alveolar, and postalveolar places of articulation. Again, liquids are all alveolar, and glides occur at labial-velar and palatal places of articulation.

Table 2-2-3: Proposed Kufo consonant inventory, shown as graphemes based on Kafi & Mongash (1998), and grouped according to place of articulation based on further discussion with the first author.

	l.-d.	bil.	dent.	alv.	p.alv.	retr.	pal.	velar	gl.
plosive		p b	t d tt			th dh	j	k g kk	‘
implosive		‘b		‘d					
nasal		m		n			ny	ng	
fricative	f v			s z	sh zh				
liquid				r rr l ll					
glide		w					y		

In Hall & Hall’s (2004) phonological overview of eight Kadu languages including Kufo, they present consonant phonemes in IPA and their

corresponding graphemes. The places and manners of articulation of the consonant phonemes are not specified, so the inventory proposed by Hall & Hall (2004) presented in Table 2-2-4 is structured based on what is usually referred to with the IPA symbols. Kadu consonants appear to occur at nine places of articulation, including bilabial, labio-dental, dental, alveolar, postalveolar, retroflex, palatal, velar, and glottal, and manners of articulation include plosives, implosives, nasals, fricatives, liquids, and glides. The pulmonic plosives occur at bilabial, dental, retroflex, palatal, velar, and glottal places of articulation, whereas implosives are found at bilabial and alveolar only, which is similar what was proposed by Schadeberg (1994) and Reh (1985). Nasals occur at bilabial, alveolar, palatal, and velar places of articulation. Fricatives can occur at labio-dental, alveolar, and postalveolar places of articulation. Hall & Hall (2004, p. 61) suggest that 'the palatal fricatives, /ʃ/ and /ʒ/, occur commonly in Kanga and Kufo', which to some extent echoes Schadeberg's (1994) suggestion that the postalveolar fricatives are allophones of the alveolar fricatives in Kufo. Liquids are all alveolar, and glides occur at labial-velar and palatal places of articulation. Prenasalisation or nasal+oral sequences are not included in the consonant inventory proposed by Hall & Hall (2004), but they do point out that there are consonant clusters in the Kadu languages, where homorganic nasals can occur before nearly all plosives and fricatives, and a few languages also allow non-homorganic sequences. The nasal in word-initial consonant clusters is proposed to be a syllabic nasal.

Table 2-2-4: Proposed Kadu consonant inventory (M. Hall & Hall, 2004, p. 59).

	bilabial	labio-dental	dental	alveolar	p.alveolar	retroflex	palatal	velar	glottal
plosive	p b		t̪ d̪			ʈ ɖ	ɟ	k g	ʔ
implosive	ɓ			ɗ					
nasal	m			n			ɲ	ŋ	
fricative		f v		s z	ʃ ʒ				
liquid				r l					
glide	w						j		

According to Dafalla (2006), Kadu consonants occur at seven places of articulation, including bilabial, dental, alveolar, retroflex, palatal, velar, and glottal, and they have seven manners of articulation, including plosive, implosive, fricative, nasal, prenasalised, glide, and liquid. Dafalla (2006) suggests that the Kadu plosives occur at all seven places of articulation, and it is worth noting that the dental plosives are contrastive with the alveolar plosives, which is not reported in any other studies on Kufo and related language varieties. The symbols /ʒ/ and /dʒ/, which generally correspond to the voiced postalveolar fricative and affricate, are presented as voiced palatal plosives by Dafalla (2006), along with the IPA symbol which represents the voiced plosive /ɟ/. As for the implosives, Dafalla (2006) suggests that they not only occur at bilabial and alveolar places of articulation as is reported in previous studies, but also at

palatal place of articulation. Fricatives occur at bilabial, alveolar, palatal, and glottal places of articulation. The alveolar fricatives are also reported by other studies, but the palatal and glottal fricatives are reported only by Dafalla (2006), and the place of articulation of the labial fricatives is bilabial instead of labio-dental, compared to what suggested in most previous studies. Regarding nasals, Dafalla (2006) suggests that they occur at bilabial, palatal, and velar places of articulation, but that there is no dental or alveolar nasal in Kadu languages. However, she proposes that the prenasalised consonants can occur at four places of articulation, including dental as well asl bilabial, palatal, and velar, where nasals precede voiced plosives. Dafalla (2006) proposes that there are three alveolar liquids, including a tap, a trill, and a lateral, and that the Kadu glides are either labial-velar or palatal.

Table 2-2-5: Proposed Kadu consonant inventory (Dafalla, 2006).

	bilabial	dental	alveolar	retroflex	palatal	velar	glottal
plosive	p b	t̪ d̪	t d	ʈ ɖ	ɟ ʒ ʤ	k g	ʔ
implosive	ɓ		ɗ		ʄ		
prenasalised	mb	nd̪			ɲɟ	ŋg	
nasal	m				ɲ	ŋ	
fricative	f v		s z		j		h
affricate							
liquid			ɾ r l				
glide	w				j		

As in previous studies, Blench & Mongash (2022) report contrasts at seven places of articulation, including labial, alveolar, postalveolar, retroflex, palatal, velar, and glottal, with six manners of articulation, including plosive, implosive, nasal, fricative, liquid, and glide. Plosives occur at labial, alveolar, retroflex, palatal, velar, and glottal places of articulation, whereas implosives only occur at bilabial and alveolar places of articulation; nasals occur at bilabial, alveolar, palatal, and velar places of articulation; fricatives are found at labio-dental, alveolar, and postalveolar places of articulation; liquids are all alveolar; glides occur at labial-velar and palatal places of articulation. Notably, the prenasalised

stops or nasal-stop sequences, which were proposed by Schadeberg (1994) for the Kadu languages, by Reh (1985) for Krongo, and described by Hall & Hall (2004), are not reported by Blench & Mongash (2022) for Kufo.

Table 2-2-6: Proposed Kufo consonant inventory (Blench & Mongash, 2022, pp. 3–4).

	labial	alveolar	p.alveolar	retroflex	palatal	velar	glottal
plosive	p b	t̪ d̪		ʈ ɖ	ɟ	k g	ʔ
implosive	ɓ	ɗ					
nasal	m	n			ɲ	ŋ	
fricative	f v	s z	ʃ ʒ				
liquid		r l					
glide	w				j		

In summary, there are few disputes regarding the places and manners of articulation of the sonorants in Kufo and the Kadu languages in general except a few that stand out in Dafalla's study (2006). Regarding nasals, most studies suggest that nasals occur at four places of articulation, including bilabial, alveolar, palatal, and velar, though Dafalla (2006) proposes only three places of articulation for Kadu nasals, with no alveolar or dental nasal. Liquids occur at the alveolar place of articulation, where there is a lateral and a trill, and possibly a tap as well. Glides occur at labial-velar and palatal places of articulation. Previous studies disagree regarding whether there is prenasalisation or nasal-oral consonant sequences in Kufo and related language varieties, and some studies

suggest that word initial nasals in consonant clusters are syllabic. It is not clear whether the components are always homorganic.

Past studies have different views on the places and manners of articulation of the obstruents in Kufo and related language varieties. Regarding plosives, most studies agree that there are plosives at bilabial, retroflex, palatal, velar, and glottal places of articulation, but there is dispute regarding whether the anterior coronal plosives are dental or alveolar (or both). As for the implosives, most studies suggest that the implosives occur at bilabial and alveolar places of articulation, though Dafalla (2006) suggest that there is also a palatal implosive. Regarding fricatives, most studies suggest that fricatives occur at labial and alveolar places of articulation, with some disagreements on if the labial fricatives are labio-dental or bilabial, and if the postalveolar fricatives are allophones of the alveolar fricatives. Dafalla (2006) suggests the existence of the voiceless palatal and glottal fricatives and the lack of the alveolar nasal.

2.2.2 Laryngeal, airstream, and length features

Previous descriptions of the consonant phonemes in Kufo and related language varieties indicate the existence of various laryngeal, airstream, and length features for plosives and fricatives, though with differing representations and interpretations. Schadeberg (1994) suggests that Kadu supralaryngeal plosives are all voiced, and that the voiced plosives contrast with the implosives, though he does note that the geminate implosives and geminate palatal plosive are neither fully voiced nor fully voiceless. Unlike the plosives, Schadeberg (1994) analyses the voiced Kadu fricatives as having corresponding voiceless phonemes.

Schadeberg (1994) also proposes that there is consonant lengthening at the start of words. In comparison, the pulmonic plosives and fricatives in Reh's (1985) Krongo consonant inventory are all represented as voiceless, with no voicing contrast, but a contrast in length, and there are also voiced implosives occurring as both short and long consonants. Kafi & Mongash (1998) propose that Kufo plosives and fricatives all exhibit a voicing contrast, implosives occur at bilabial and alveolar places of articulation, and the length contrast exists for the voiceless alveolar plosive, the voiceless velar plosive, and the laterals. Hall & Hall (2004) suggest that all Kadu plosives and fricatives, except the palatal plosive and glottal stop, exhibit a voicing contrast, with implosives occurring at bilabial and alveolar places of articulation, and that Kadu consonants exhibit a voicing contrast, though there is no detailed discussion for singleton versus geminate plosives and fricatives. Interestingly, Hall & Hall (2004) note that "voicing of plosives has only been found to be contrastive for Kanga and Kufo" (M. Hall & Hall, 2004, p. 60), and that the "geminate explosives are always voiceless" (M. Hall & Hall, 2004, p. 61). Furthermore, though there is no general discussion on Kufo or Kadu phonotactics, a few phonotactic characteristics are suggested by Hall & Hall (2004) when discussing consonant length. Hall & Hall (2004) suggest that the syllables the Kadu languages general have the basic structure "(onset) nucleus (coda)" (M. Hall & Hall, 2004, p. 66) and that long vowels are generally not the nucleus of closed syllables. Hall & Hall (2004) also note that word final consonants are quite restricted in most Kadu languages, and they suggest that geminate consonants consist of "the coda of one syllable with the co-articulated onset of the following syllable" (M. Hall & Hall, 2004, p. 61).

Dafalla (2006) suggests that Kadu plosives and fricatives at labial, alveolar, retroflex, and velar places of articulation exhibit a voicing contrast, whereas those at postalveolar, palatal, and glottal places of articulation do not; no length contrast is proposed. Blench & Mongash (2022) suggest a voicing contrast for all Kufo plosives and fricatives except the glottal stop, with implosives occurring at bilabial and alveolar places of articulation, yet there is no discussion regarding gemination.

Some of the proposed features of the Kufo and Kadu consonants are of particular typological interest, and crosslinguistically understudied. Previous crosslinguistic overviews of long or geminate consonants show that there is a great diversity in the composition of geminate inventories, where in some languages all singletons contrast with geminates, whereas in others only some consonants show a length contrast (Blevins, 2004, 2008). While long consonants in some African languages, such as those of the Afroasiatic family, e.g., Tashlhiyt Berber (Ridouane, 2007), have been studied in detail, very few other languages of Africa have been included in the crosslinguistic surveys or the focus of targeted studies. The primary phonetic cue to consonant length contrasts is the difference in closure duration, with long consonants generally about 1.5 to 3 times as long as the short ones (Ladefoged & Maddieson, 1996, p. 92).

2.3 Vowels

2.3.1 Vowel quality

Schadeberg (1994) suggests that all nine Kadu languages appear to have a basic seven vowel system, as shown in Table 2-3-1, including three front vowels /i, ɪ, ɛ/, three back vowels /u, ʊ, ɔ/, and one central vowel /a/. Schadeberg (1994) suggests that the vowels [e] and [o], which occasionally occur in the data, are respectively not distinct from /ɪ/ and /ʊ/.

Table 2-3-1: Proposed Kadu vowel inventory (Schadeberg, 1994, p. 18).

i	ɪ	ɛ	a	ɔ	o	u

Similarly, Reh (1985) proposes that Krongo, which is closely related to Kufo, has seven distinctive vowel qualities, including three front unrounded vowels /i, ɪ, e/, three back rounded vowels /u, ʊ, o/, and one open central vowel /a/, though she reports that the phonemic status of /e/ is unclear.

Table 2-3-2: Proposed Krongo vowel inventory (Reh, 1985, p. 28).

	[+ATR]		[-ATR]	
	[+front]	[+back]	[+front]	[+back]
[+close]	/i, ii/	/u, uu/	/ɪ/	/ʊ, ʊʊ/
			/ee/	
[+open]		/o, oo/	/a, aa/	
unclear phonemic status	/e/, /ee/			

Hall & Hall (2004) suggest that Kufo, along with Kadugli, Kanga, Katcha, and Keiga, has instead a 9-vowel system, which is presented below in Table 2-3-3, including four front unrounded vowels /i, ɪ, e, ɛ/, four back rounded vowels /u, ʊ, o, ɔ/, and one central vowel. Hall & Hall (2004) note that though a ten-vowel system with an additional central vowel is proposed for some Kadu languages, e.g., Kamda and Keiga, there are very few examples of contrast for /a/ and /ə/ in these languages, and there is no evidence that [a] and [ə] contrast in Kufo.

Table 2-3-3: Proposed Kadu vowel inventory (M. Hall & Hall, 2004, p. 62).

[+ATR]	phoneme	ɪ	ɛ	a	ʊ	ɔ
	grapheme	I i	E e	A a	U u	O o
[-ATR]	phoneme	i	e	/ə/ or [ə]	u	o
	grapheme	Ix ix	Ex ex	A a	Ux ux	Ox ox

Differing from Hall & Hall (2004), Dafalla (2006) suggests that the Kadu languages have ten vowels, including four unrounded front vowels /i, ɪ, e, ɛ/, four rounded back vowels /u, ʊ, o, ɔ/, as well as two central vowels /ə, a/. Compared to other previous studies, Dafalla (2006) reports the central vowels /ə/ and /a/ as contrastive phonemes, though no evidence is provided for this contrast. Moreover, in Dafalla's (2006) transcription, Kufo appears to have diphthongs or vowel sequences, which seem to have little restriction regarding the components, yet this is not discussed in her phonological description.

Table 2-3-4: Proposed Kadu vowel inventory (Dafalla, 2006, p. 158).

	front	central	back
close	i ɪ		ʊ u
close-mid	e		o
open-mid	ɛ	ə	ɔ
open		a	

Blench & Mongash (2022) suggest that Kufo has ten contrastive vowel phonemes, including four front unrounded vowels /i, ɪ, e, ɛ/, four back rounded vowels /u, ʊ, o, ɔ/, and two central vowels /a, ə/, which is similar to what is reported by Dafalla (2006). Blench & Mongash (2022) note that though presented with the same grapheme <a>, the open central vowel /ə/ and the near-open central vowel /a/ "are clearly phonemes", but these and other contrasts are not discussed further.

Table 2-3-5: Proposed Kufo vowel inventory (Blench & Mongash, 2022, p. 2).

	front	central	back
close	i ɪ		u ʊ
close-mid	e		o
open-mid	ɛ	ə	ɔ
near-open		a	

Kafi & Mongash (1998) propose a Kufo alphabet presenting ten different orthographical representations for vowels, <a, ax, e, ex, i, ix, o, ox, u, ux>, which

likely are intended to correspond to ten distinct vowel qualities. The closeness, frontness, and roundness of the vowels are interpreted based on discussions with the speaker in the present study, Haroun Kafi, who as noted is a co-author of the alphabet book. The proposed Kufo inventory based on the alphabet book (Kafi & Mongash, 1998) is presented in Table 2-3-6. As discussed further in Section 2.3.2, the <x> component of vowel graphemes is a convention used for the languages of this region to indicate 'Advanced Tongue Root' differences. The vowel quality that corresponds to <ax> is interpreted with the least certainty, mainly based on what is possible in terms of articulatory settings; if <ax> is a [+ATR] counterpart to /a/, it would likely be a mid or open-mid central vowel /ə/ or /ɜ/ (Casali, 2008). The fact that <a> and <ax> are different graphemes suggests that there may be some sort of perceived phonemic contrast exhibit by the central vowels, unlike the descriptions of Schadeberg (1994) and Reh (1985), yet no minimal pair is presented in the examples that are included in the alphabet book.

Table 2-3-6: Proposed Kufo vowel inventory, shown as graphemes based on Kafi & Mongash (1998), and grouped according to backness based on further discussion with the first author.

	front	central	back
close	<ix>		<ux>
near-close	<i>		<u>
close-mid	<ex>		<ox>
mid		<ax>	
open-mid	<e>		<o>
near-open		<a>	

2.3.2 The 'Advanced Tongue Root' distinction

Various previous studies propose that the Kadu vowel systems exhibit an 'Advanced Tongue Root' (ATR) contrast. An Advanced Tongue Root (ATR) contrast is a binary distinction between vowels of similar height, backness, and rounding, held to correlate with different pharyngeal and laryngeal articulatory settings (Casali, 2008). Hall & Hall (2004) suggest that the nine Kadu vowels /i, ɪ, e, ɛ, a, ɔ, o, ʊ, u/ exhibit an ATR contrast, with /i, e, o, u/ as the [+ATR] vowels and /ɪ, ɛ, a, ɔ, ʊ/ as the [-ATR] vowels, and also with [ə] as a [+ATR] allophone of /a/. Dafalla (2006) similarly categorises the ten Kadu vowels into two groups, and the [+ATR] group consists of /i, e, ə, o, u/ and the [-ATR] group consists of /ɪ, ɛ, a, ɔ, ʊ/, but the ATR contrast is not represented in the wordlist data which accompanies the phonological description. In Reh's (1985) description of Krongo, the seven Krongo vowels are categorised into two groups based on an ATR contrast, with /i, o, u/ as the [+ATR] vowels and /ɪ, a, ʊ/ as the [-ATR] vowels; /e/, which had an unclear status, does not have an ATR categorisation.

Regarding Kufo specifically, the ATR feature is not explicitly discussed in the alphabet book (Kafi & Mongash, 1998), but the chosen graphemes correspond to an established convention in literacy materials for Nuba Mountain languages to use the graphemes <a, e, i, o, u> to refer to [-ATR] vowels and the graphemes <ax, ex, ix, ox, ux> to refer to the [+ATR] vowels (as also shown in Hall & Hall 2004). Blench & Mongash (2022) propose that the ten Kufo vowels can be categorised into a [+ATR] group /i, e, ə, o, u/ and a [-ATR] group /ɪ, ɛ, a, ɔ, ʊ/.

Advanced Tongue Root distinctions are attested for many African languages. For languages with an ATR contrast, a 9-vowel system is most common, where there are two [+/-ATR] pairs of close vowels, two [+/-ATR] pairs of mid vowels, and one open vowel (R. M. R. Hall & Creider, 1998). Existing phonetic investigations of ATR contrasts remain limited, and mainly focus on Niger-Congo languages of West Africa, with few phonetic studies of East African languages, including Lopit (Billington, 2014) and Maa (Guion et al., 2004). The phonetic investigations suggest that the most crosslinguistically reliable acoustic correlate is that vowels classed as Advanced Tongue Root ([+ATR]) tend to have a lower first formant frequency (F1) than their Retracted Tongue Root ([-ATR]) counterparts. Other evidence, such as differences in second formant frequency (F2), duration, and voice quality, are less consistent (Casali, 2008).

In many languages with ATR contrasts, there are also vowel harmony processes involving [+/-ATR] vowel qualities. Some early studies of the Kadu languages suggest that there is no evidence of any kind of vowel harmony; as is stated by Schadeberg (1994), all seven vowels appear to be "compatible within words". However, Hall & Hall (2004) state that "some kind of vowel harmony, based on the [+/-ATR] feature, seems to operate in some of the languages", and that the harmony is commonly observed in roots, yet not consistently in affix vowels. The environment in which [ə] occurs, which is proposed to be the [+ATR] allophone of the central vowel /a/, is not specified by Hall & Hall. Blench & Mongash (2022) suggests that the vowels can be categorised as [+/-ATR] harmony sets, but no detailed discussion is presented.

2.3.3 Vowel length

For Kufo and the Kadu languages, vowel length has been briefly mentioned in previous studies, but there are differing views on the status of length within the vowel system. Schadeberg (1994) suggests that all seven vowels that he proposes can occur either short or long, and also notes that word-final vowels are always short. Comparatively, Reh (1985) similarly proposes that six of the seven Krongo vowels, including /i, e, a, o, ʊ, u/, can occur either short or long, though a length distinction is not observed for the unrounded near-close front vowel /ɪ/. Hall & Hall (2004) suggest that vowel length in contrastive for the Kadu languages, and present examples of the long close back vowel /uː/ and near-close back vowel /ʊː/, though it is unspecified whether the vowel length contrast applies to all vowel qualities in Kufo, or across the Kadu languages.

For previous studies where a vowel length contrast is not explicitly discussed, some evidence for long vowels can be observed in transcribed examples which include doubling of the graphemes for the short vowels, for example in the alphabet book (Kafi & Mongash, 1998), e.g. for 'body' *oona*. In the alphabet book (Kafi & Mongash, 1998), all vowels, except <ax>, have a long counterpart. In Dafalla's (2006) transcription, long vowels occur in several Kadu languages, e.g., 'hand' *niizo* in both Katcha and Kamda and *neeso* in Shororo/Kursi. The only occurrence of a long vowel across the Dafalla's (2006)transcription of 179 words in Kufo is 'porridge' *koroove*. In the description of Kufo phonology by Blench & Mongash (2022), a vowel length contrast is again not discussed, but is presented in their orthographic transcription of the wordlist, where the graphemes of the short vowels are doubled, e.g., 'hills' *jeene*.

Vowel length contrasts are typologically uncommon among African languages. While vowel length contrasts have been proposed for some East African languages, the phonetic evidence for these contrasts has not been examined for many languages outside the Western Nilotic family, for example in Ageer Dinka (Remijsen, 2014) and Shilluk (Remijsen et al., 2019).

2.4 Tone

Schadeberg (1994, p. 18) suggests that all Kadu languages are "almost certainly tone languages", and that he proposes a two tone system where there is a high tone and a low tone. He notes that contour tones are rare but he has "occasionally heard and marked downstep" (Schadeberg, 1994, p. 18). In Schadeberg's (1994) transcription, high tone is marked with an acute accent, whereas low tone is unmarked. Reh (1985) suggests that for Krongo there is a high tone and a low tone, respectively marked with an acute and a grave accent, and that the tones can indicate both lexical and grammatical distinctions. Grammatically, Krongo tones are found to be used to distinguish the completive and incompletive aspects of verbs. Tone is not discussed or marked in the Alphabet Book by Kafi & Mongash (1998) or by Dafalla (2006). Hall & Hall (2004) note that though the tone system has not been fully analysed for any Kadu language, they find that Kadu languages generally have two tones, "with a considerable amount of pitch conditioning" (M. Hall & Hall, 2004, p. 65). They also speculate that tone likely carries a higher grammatical functional load since there are few lexical contrasts based on tone. Tone is not discussed by Blench & Mongash (2022), but there are two tone markings in their transcription, the acute and grave accents, which likely correspond to perceived high and low tones.

Tone is very common among African languages, and African tone languages generally have small tone inventories of mostly level tones (Clements & Rialland, 2007). African tone systems have played a crucial role in phonological theory, particularly in the area of autosegmental phonology, with the identification of specific properties of African tone including tone spread and shift, floating tones and tone melodies, and downstep (Odden, 2020). However, the tone systems of languages of East Africa have received less attention than the tone systems of languages of West Africa.

Chapter 3 Methodology

3.1 Introduction

This chapter presents the methodology adopted by the project. Section 3.2 introduces the participant. Section 3.3 provides a general overview of the materials and procedures, including data collection, processing, and analysis. More details on the acoustic phonetic databases will be introduced in Sections 4.4, 5.3, and 6.3, which respectively focus on plosives, vowels, and tone.

3.2 Participant

The data for phonological and acoustic analyses was collected with one male diasporic Kufo speaker, Haroun Kafi, who moved to Australia in 2005 and currently resides in Victoria. Born in the 1960s, Haroun is a native speaker of the Kufo language, and, as noted in Section 1.2, is the co-author of the Kufo alphabet book (Kafi & Mongash, 1998). Besides Kufo, Haroun also speaks Sudanese Arabic and English. In Australia, there is no reported Kufo speaking community, and Haroun appears to be the only Kufo speaker.

3.3 Materials and procedures

3.3.1 Materials

This Honours project follows on from the 2021 Field Methods in Linguistics course at the Australian National University. Before the Field Methods course, materials on Kufo and related language varieties, as discussed in section 2.1, were extremely limited. During the course, lexical data was elicited using

developed wordlists (Swadesh, 1952, 1955) with a focus on nouns, morphosyntactic structure was explored, some naturalistic speech was collected, and a preliminary orthography was suggested (Evans et al., 2021). The current project expanded the lexical data using the SIL comparative African wordlist (Snider & Roberts, 2004) and books on African animals (Redman et al., 2016), with a focus on precise animal terms, verbs, and adjectives. This project also collected naturalistic speech on traditional customs to inform understandings of the Kufo culture as well as observe phonological features in fluent speech. Other materials produced during this project include African story books both for educational purposes for the Kufo community and as part of explorations of the Kufo language. After auditory impressions on features of particular interest have been developed based on descriptive phonological data, wordlists targeting these features were designed to collected acoustic phonetic data.

3.3.2 Data collection

Descriptive phonological data was collected with different equipment in different stages, depending on the emerging understanding of Kufo phonology, the need for high quality recording for acoustic analysis, and whether the data collection sessions were held online or in person during two ten-day fieldtrips from Canberra to regional Victoria. Data was collected between November 2021 and October 2022. At the start of this project, visual and audio data was collected remotely via Zoom online meeting software each week, and data collection sessions focused on following up specific aspects of interest from the Field Methods course and eliciting more lexical data to test hypotheses and prepare for future wordlist design. During fieldtrips when in person data collection was

possible, data was collected with a Zoom H6 portable audio recorder and a Rode NT3 microphone, at an archival sampling rate of 96kHz and 24-bit depth. Meanwhile, the speaker was trained to independently record audio data. Therefore, sessions from July 2022 were recorded via both Zoom online meeting software by the researcher and a Zoom H5 portable audio recorder with a head-mounted SHURE microphone by the speaker. Acoustic phonetic data and naturalistic speech were recorded either during fieldtrips by the researcher, or in later stage of this project by the speaker. All data collected for this project is archived with the Pacific and Regional Archive for Digital Sources in Endangered Cultures (Li, 2022).

3.3.3 Data processing and analysis

Lexical data was transcribed in IPA during data collection sessions by hand in notebooks, and the videos, audios and scanned fieldnotes are archived. For acoustic phonetic data and naturalistic speech, the recorded data (.wav files) were first downsampled to a rate of 44.1kHz and 16 bit-depth for analysis. Naturalistic speech was segmented and annotated in ELAN (The Language Archive, 2022) with orthographic transcription in Kufo and corresponding translations in English. After downsampling, data intended for acoustic analysis was segmented and annotated in Praat (Boersma & Weenink, 2001) as .TextGrid files. The annotation consists of four tiers, including the word tier which contains the English translation of the target Kufo word, the syllable tier which contains the tone marking (1 for low and 5 for high), the phoneme tier which contains the segmental annotation using SAMPA (Wells, 1995), and the phonetic tier which is reserved for voice onset time in the plosive database (further details of the

plosive database will be introduced in Section 4.4). Hierarchical databases for acoustic analyses were created using the .wav files and corresponding .TextGrid files with the EMU Speech Database Management System (Winkelmann et al., 2017), and acoustic measurements were extracted and analysed using the emuR package (Winkelmann et al., 2021) in R (R Core Team, 2021) via RStudio (RStudio Team, 2022).

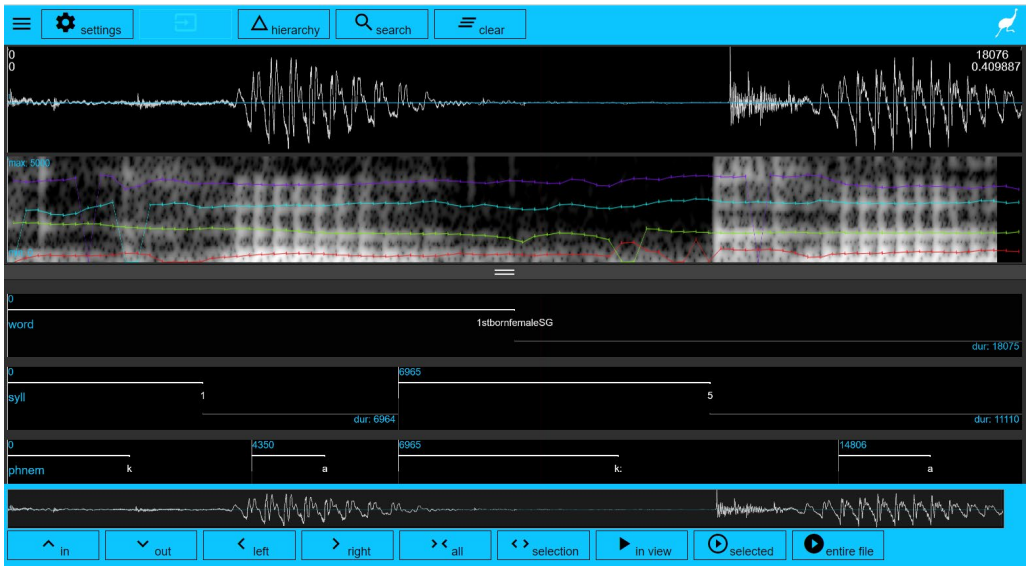

Figure 3-1: A screen shot of the user interface of EMU-SDMS. From top to bottom: waveform, spectrogram with formant frequency tracking, word tier with English translation, syllable tier with tone marking, and phoneme tier with SAMPA transcription. The phonetic tier is not shown in this screenshot but is discussed in Section 4.4.

Chapter 4 Consonants

4.1 Introduction

This chapter focuses on Kufo consonants. Section 4.2 discusses the consonant phonemes and phonological observations and introduces the Kufo consonants grouped by manners of articulation, firstly plosives, then implosives, fricatives, nasals, liquids, and glides. Section 4.3 presents the results of the database with a focus on intervocalic plosives. The examples presented in this chapter are included in Appendix E.

4.2 Consonant phonemes

Based on data collected for the current study, Kufo has 30 consonants. The consonant inventory is presented in Table 4-1. Kufo consonants occur at eight places of articulation, including labio-dental, bilabial, dental, alveolar, retroflex, palatal, velar, and glottal, and they have six manners of articulation, including plosive, implosive, fricative, nasal, liquid, and glide. Regarding the places and manners of articulation, pulmonic plosives occur at bilabial, dental, retroflex, palatal, velar, and glottal places of articulation, implosives occur at bilabial and alveolar places of articulation, fricatives occur at labio-dental and alveolar places of articulation, nasals occur at bilabial, alveolar, palatal, and velar places of articulation, liquids include an alveolar tap, alveolar trill, and alveolar laterals, and glides include labial-velar glide and palatal glides.

Table 4-1: Kufo consonant inventory.

	bilabial	labio-dental	dental	alveolar	retroflex	palatal	velar	glottal
plosive	p pː b̪ː		t̪ t̪ː		ʈ ʈː	c	k kː	ʔ
implosive	ɓ			ɗ				
fricative		f fː		s sː				
nasal	m			n nː		ɲ ɲː	ŋ	
tap				ɾ				
trill				r				
lat.approx.				l lː				
approx..	w					j jː		

4.2.1 Plosives

/p/, /pː/ & /ɓ/

At the bilabial place of articulation, there are three contrastive plosive phonemes, including the short bilabial plosive /p/, the long voiceless bilabial plosive /pː/, and the bilabial implosive /ɓ/. The evidence for contrast is presented at word initial position for /p/ and /ɓ/ in Example 4-1.a compared to Example 4-1.b and Figure 4-1.a, and intervocalically for /p/, /pː/, and /ɓ/ in Example 4-1.c compared to Example 4-1.d compared to Example 4-1.e as well as in Figure 4-1.b and Figure 4.1.c.

The short bilabial plosive /p/ can occur in word initial and medial positions. /p/ is realised as the long voiced bilabial plosive [bː] between voiced segments, and as the voiceless bilabial plosive [p] otherwise, which is generally unaspirated. The voiced realisation of /p/ differs from short plosives at other places of articulation, as to be introduced in this section, are often realised as a short voiced plosive at corresponding places of articulation. However, /p/ appears to carry a low functional load, since it is found word-initially in one lexical item (Example 4-1.a) and intervocalically in two lexical items only (one of which is presented in Example 4-1.c). Therefore, more data is required to better understand the phonemic status and phonetic realisations of /p/ and [bː].

The long bilabial plosive /pː/ occurs intervocalically only and is always voiceless and unaspirated, which is typical across the long plosives in Kufo. Like its short

counterpart, /p:/ also appears to have an extremely low functional load in Kufo, and the only lexeme with /p:/ in current data is presented in Example 4-1.d.

The bilabial implosive /ɓ/ can occur in word initial and medial positions, and it can follow the glottal stop, for example in Example 4-1.g. These sequences were proposed to be a "long implosive" by Schadeberg (1994). However, as can be seen in Figure 4-1.d, there is not voicing throughout the whole closure, but only towards the end.

(4-1)	a.	/páʔjá/	[páʔjá]	all[20221006]
	b.	/ɓàkà/	[ɓàgà]	mad person[20220506]
	c.	/t̪àpá:ná/	[t̪àb:á:ná]	hit INF[20221006]
	d.	/náp:á/	[náp:á]	fathers PL[20220811]
	e.	/t̪àɓá:ná/	[t̪àɓá:ná]	pass INF[20221006]
	f.	/kàʔɓá/	[kàʔɓá]	large thresher SG[20220811]

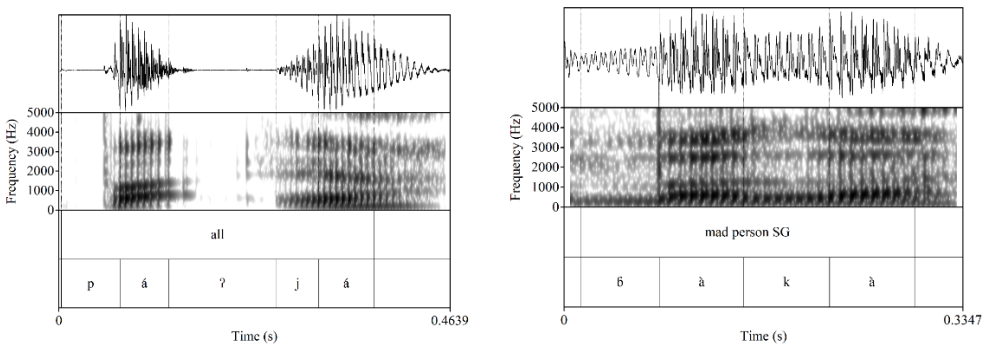

Figure 4-1.a: Spectrograms and waveforms showing examples of the pulmonic bilabial plosive /p/ (left) contrasting with the bilabial implosive /ɓ/ (right) in word initial position.

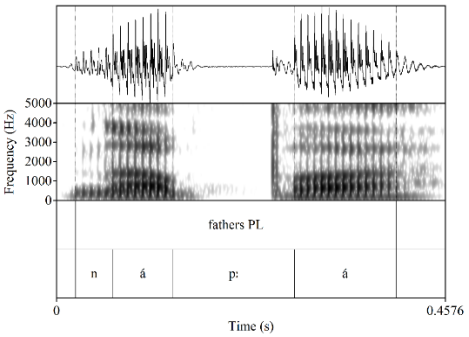

Figure 4-1.b: Spectrogram and waveform showing an example of intervocalic long voiceless bilabial plosive /p:/ appearing in a disyllabic word, with a closure duration of 143ms.

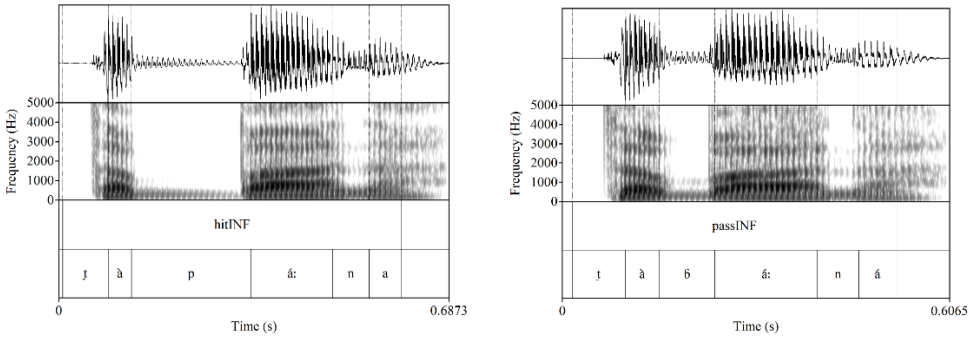

Figure 4-1.c: Spectrograms and waveforms showing examples of the short bilabial plosive /p/ (left), which is realised as voiced bilabial plosive [b:] with a closure duration of 193ms, contrasting with the bilabial implosive /ɓ/ (right) with a closure duration of 87ms, both occurring in intervocalic position in trisyllabic words.

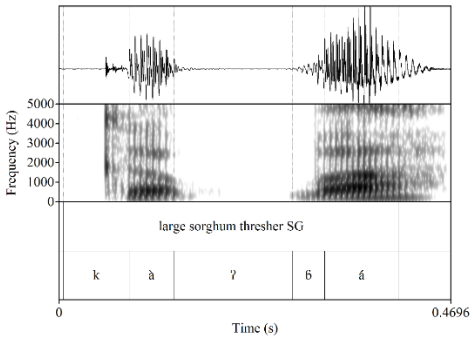

Figure 4-1.d: Spectrogram and waveform showing an example of the bilabial implosive /ɓ/ following a glottal stop /ʔ/ in word medial position. This consonant sequence was proposed to be a "long implosive" by Schadeberg (1994).

/t̪/, /t̪ː/ & /ɗ/

At the dental and alveolar places of articulation, there are three contrastive plosive phonemes, including the short dental plosive /t̪/, the long voiceless dental plosive /t̪ː/, and the alveolar implosive /ɗ/. Past studies have different views regarding the place of articulation of the anterior coronal plosives, and observations of data collected for the current project suggest that the anterior coronal pulmonic plosives are dental, whereas the anterior coronal implosive is alveolar.

The short dental plosive /t̪/ is found in word initial and medial positions, and /t̪/ is realised as the voiced dental plosive [d̪] between voiced segments, and as the unaspirated voiceless dental plosive [t̪] otherwise, which is commonly observed across short plosives and fricatives in Kufo. The voicing change from [t̪] to [d̪] can be observed in morphophonological processes such as pluralisation, where a CV- prefix is attached to the singular noun form, resulting in the consonants in word initial positions occurring between voiced segments instead, as can be seen in Example 4-2.a and Figure 4-1.a (left) compared to Example 4-2.c and Figure 4-1.b (left), where /t̪/ is realised as [t̪] word initially in the singular noun form and as [d̪] instead intervocalically in the plural noun form.

The alveolar implosive /ɗ/ occurs in word initial and medial positions. Similar to its bilabial counterpart /ɓ/, /ɗ/ can follow the glottal stop, and these sequences were also described as a "long implosive" by Schadeberg (1994). Evidence for contrast is presented for /t̪/ and /ɗ/ word initially in Example 4-2.a compared to Example 4-2.b and Figure 4-2.a, and intervocalically in Example 4-2.c compared

to Example 4-2.d and Figure 4-2.b. Compared to /t̪/ [d̪], /ɗ/ has a shorter duration and does not appear to have any drop of amplitude in the middle or burst towards the end.

The long voiceless dental plosive /t̪ː/, like its bilabial counterpart /pː/, occurs intervocalically only and is always voiceless and unaspirated. The length of the geminate /t̪ː/ is preserved in morphophonological processes, for example in noun pluralisation, which is presented in Example 4-2.e and Example 4-2.f as well as Figure 4-2.c.

(4-2)	a.	/t̪ɔ́lɔ́/	[t̪ɔ́lɔ́]	container SG^{20220915_2}
	b.	/ɗɔ̃lɔ́/	[ɗɔ̃lɔ́]	k.o. stick SG^{20220915_2}
	c.	/náːt̪ɔ́lɔ́/	[náːd̪ɔ́lɔ́]	containers PL^{20220915_2}
	d.	/náːɗɔ̃lɔ́/	[náːɗɔ̃lɔ́]	k.o. sticks PL^{20220915_2}
	e.	/mòt̪ːó/	[mòt̪ːó]	horse SG^{20221014}
	f.	/nàkòtːó/	[nàgòtːó]	horses PL^{20221014}
	g.	/t̪ìʔdĭ/	[t̪ìʔdĭ]	love INF^{20220811}

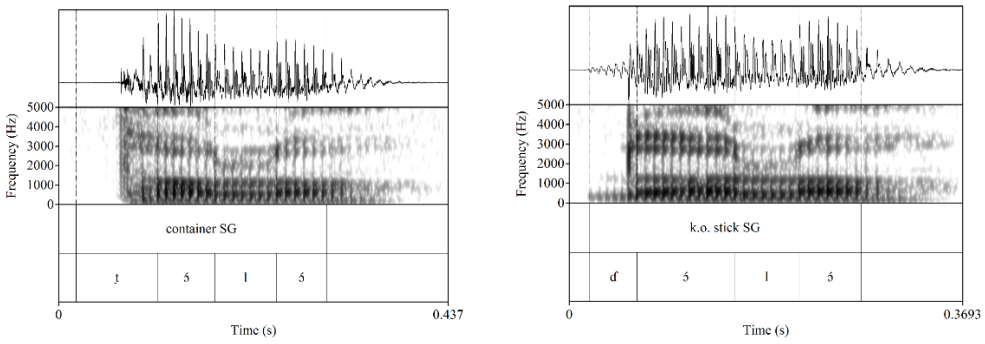

Figure 4-2.a: Spectrograms and waveforms showing examples of the dental plosive /t̪/ (left), which is realised as the voiceless plosive [t̪], contrasting with the alveolar implosive /d/ (right), both occurring in word initial position.

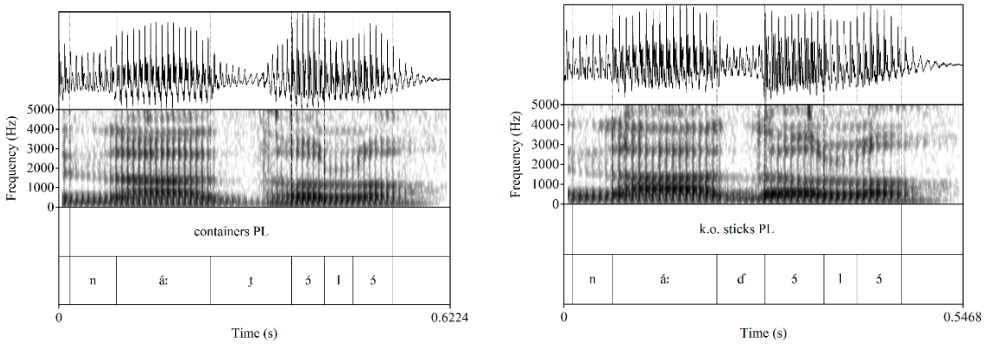

Figure 4-2.b: Spectrograms and waveforms showing examples of the dental plosive /t̪/ (left) contrasting with the alveolar implosive /d/ (right) in intervocalic position. The dental plosive /t̪/ is intervocalic and realised as the voiced plosive [d̪] with a closure duration of 130ms, whereas the alveolar implosive /d/ has a closure duration of 65ms.

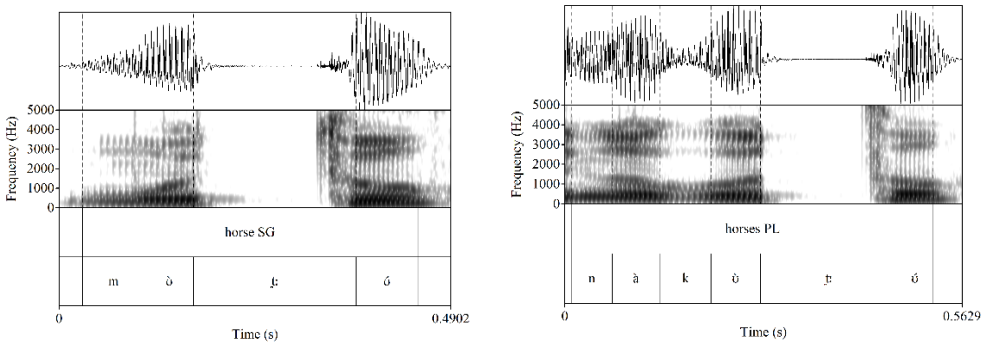

Figure 4-2.c: Spectrograms and waveforms showing examples of the closure duration of intervocalic long dental plosive /t̪:/ being preserved in morphophonological processes such as pluralisation, with a closure duration of 203ms in its disyllabic singular form (left) and 193ms in its trisyllabic plural form (right).

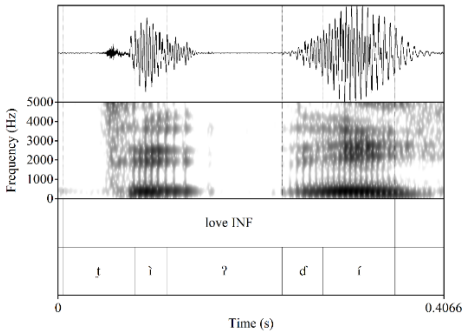

Figure 4-2.d: Spectrogram and waveform showing an example of the alveolar implosive /ɗ/ following a glottal stop /ʔ/ in word medial position. This consonant sequence was proposed to be a "long implosive" by Schadeberg (1994).

/c/

One plosive phoneme, /c/, is found at the palatal place of articulation. Auditory impressions are that the palatal plosive /c/ is often dorsal rather than coronal, and no evidence of a length or voicing contrast has yet been found for the palatal plosive.

/c/ occurs in word initial and medial positions. Similar to other short plosives, /c/ is realised as the voiced plosive [ɟ] between voiced segments, and as the unaspirated voiceless plosive [c] otherwise, for example [c] word initially in the imperative verb form in Example 4-3.a and Figure 4-3 (left), and as [ɟ] intervocalically in the corresponding infinitive verb form in Example 4-3.b and Figure 4-3 (right), which is constructed by adding a CV-prefix to the imperative form. Intervocalically, /c/ [ɟ] is often found to be reduced to a palatal glide /j/ in fluent speech, as shown in Examples (4-3.c) and (4-3.d).

(4-3)	a.	/cɛ́ːnɛ́/	[cɛ́ːnɛ́]	wake up IMP^{20220915_4}
	b.	/t̪àcɛ́ːnɛ́/	[t̪àɟɛ́ːnɛ́]	wake up INF^{20220915_4}

c.	/ʈaculo/	[ʈaɟulo]	greet INF[20221014]
d.	/ʈaculo/	[ʈajulo]	greet INF[20221014]

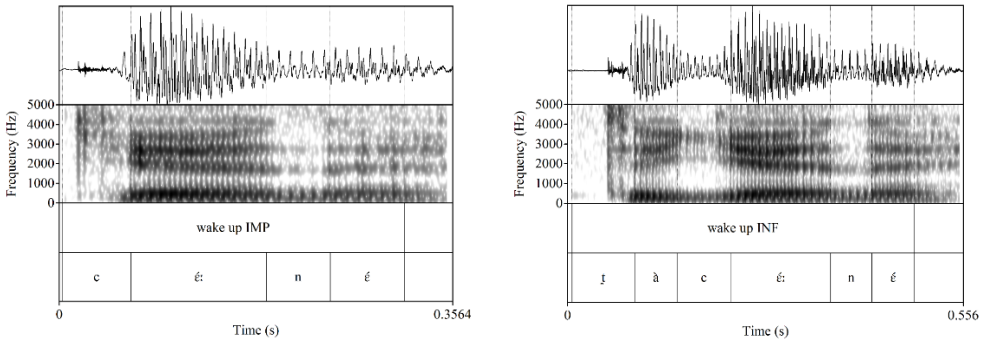

Figure 4-3: Spectrograms and waveforms showing examples of the palatal plosive /c/ in word initial position and intervocalic position, respectively realised as the voiceless palatal plosive [c] and the voiced palatal plosive [ɟ].

/ʈ/ & /ʈː/

Two contrastive phonemes are found at the retroflex place of articulation, including the short retroflex plosive /ʈ/ and the long voiceless retroflex plosive /ʈː/. Auditory impressions are that the retroflex plosives are generally a bit affricated, which can be observed in the spectrograms presented in Figure 4-4.a and Figure 4-4.b.

The short retroflex plosive /ʈ/ occurs in word initial and medial positions. /ʈ/ is realised as the voiced retroflex plosive [ɖ] between voiced segments, and as [ʈ] otherwise, similar to the characteristics noted for other short plosives. Example 4-4.a and Example 4-4.b present the voicing from [ʈ] to [ɖ] in noun singularisation, where the [ʈ] in word initial position of the plural noun form changes to [ɖ] in the singular noun form after a syllabic nasal is inserted in front, and the corresponding spectrograms and waveforms are presented in Figure 4-4.a.

The long retroflex plosive /ʈː/ occurs intervocalically only and is always voiceless. The evidence of intervocalic contrast between the retroflex plosive singleton and geminate is presented in Example 4-4.c compared to Example 4-4.d as well as in Figure 4-4.b.

(4-4)	a.	/ʈáːɾú/	[ʈáːɾú]	leaf SG[20221006]
	b.	/ɳʈáːɾú/	[ɳɖáːɾú]	leaves PL[20221006]
	c.	/ʈ̪àʈá/	[ʈ̪àɖá]	skin INF[20220811]
	d.	/ʈ̪àʈːá/	[ʈ̪àʈːá]	cut INF[20220811]

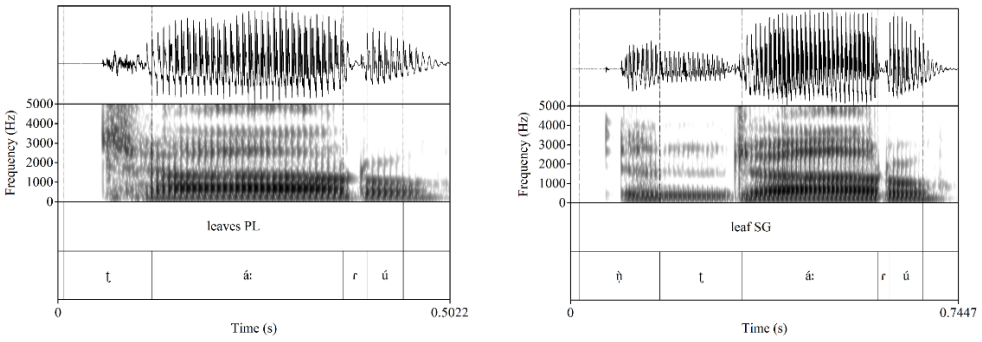

Figure 4-4.a: Spectrograms and waveforms showing examples of the short retroflex plosive /ʈ/ in word initial position (left), and between voiced segments after a syllabic alveolar nasal /ɳ/ is added in front in the singularisation process, where the short retroflex plosive /ʈ/ is realised as the voiced retroflex plosive [ɖ] (right).

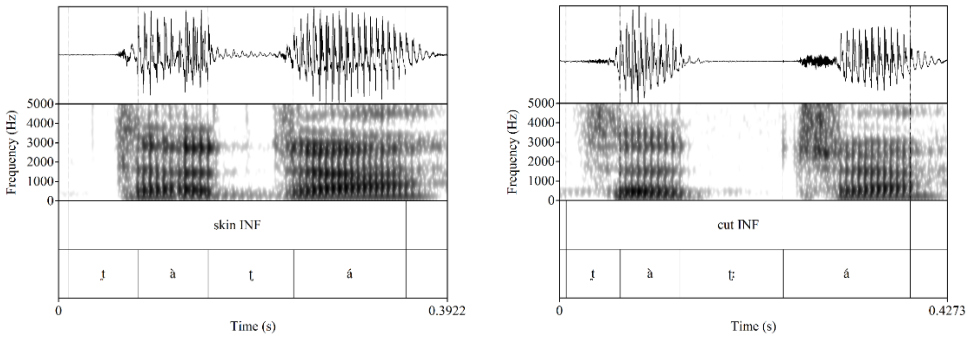

Figure 4-4.b: : Spectrograms and waveforms showing examples of the short retroflex plosive /ʈ/ (left), which is realised as the voiced retroflex plosive [ɖ] with a closure duration of 86 ms, contrasting with the long voiceless retroflex plosive /ʈː/ (right),which has a closure duration of 114ms, both occurring intervocalically in disyllabic words.

One interesting phenomenon that is found to be realised in various ways in Kufo is adjective intensification. In this process, the intervocalic short retroflex plosive /ʈ/, which is realised as the voiced retroflex plosive [ɖ] in the non-intensified form of the adjective (Example 4-4.e), appears to transform into the long voiceless retroflex plosive /ʈː/ in the intensified form (Example 4-4.f), as can be seen in Figure 4-4.c. The general introduction of intensification will be presented in Section 4.3, and the examples of the realisation of intensification will be further discussed for the long voiceless velar plosive /kː/, the glottal stop /ʔ/, and the long alveolar lateral /lː/ in Section 4.2, as well as for the open central vowel /a/ in Section 5.2.

(4-4)	e.	/káʈá/	[káɖâ]	ahead[20221006]
	f.	/káʈːá/	[káʈːâ]	ahead INT[20221006]

/k/ & /kː/

At the velar place of articulation, there are two contrastive plosive phonemes, including the short velar plosive /k/ and the long voiceless velar plosive /kː/.

The short velar plosive /k/ can occur in word initial and medial positions. Like other short plosives, /k/ is realised as the voiced velar plosive [g] between voiced segments, and as the unaspirated voiceless velar plosive [k] otherwise, for example word initially as [k] in the singular noun form in Example 4-5.a and Figure 4-5.a (left), and as [g] intervocalically in the corresponding plural noun form in Example 4-5.b and Figure 4-5.b (right). The voicing change of the word initial /k/ appears to be sometimes unstable in morphophonological processes such as pluralisation, which involves prefixation on the noun, and the word initial /k/ can remain voiceless instead of being voiced, for example in Example 4-5.c compared to Example 4-5.d.

The long velar plosive /kː/ occurs intervocalically only and is always voiceless, and it is contrastive with the short velar plosive /k/, as can be seen in Example 4-5.e compared to Example 4-5.f as well as Figure 4-5.b. Similar to other geminate plosives, the duration of /kː/ remains through morphophonological processes, for example in pluralisation in Example 4-5.a compared to Example 4-5.b and in Figure 4-5.a.

One interesting feature is that word initially, /k/ is found to be occasionally voiced in imperative forms of some Kufo verbs. Kufo verbs generally derive from the nouns, for example the noun for ‘food’ in Example 4-5.g can derive into the infinitive form for ‘eat’ /t̪àkòrì/ [t̪àgòrì], and then the imperative form

‘Eat!’ in Example 4-5.h. While the word initial consonants in many imperative verb forms are voiceless, some are voiced possibly due to the loss of an initial V- syllable which may still be preserved in other languages, as is suggested in the transcription of ‘Eat!’ by Schadeberg (1994, p. 16) for Miri, Tolobi, Krongo, and Talasa, *aguri*.

(4-5)	a.	/kàk:á/	[kàk:á]	1st born female SG[20220704]
	b.	/nàkàk:á/	[nàgàk:á]	1st born female PL[20220704]
	c.	/kìk:í/	[kìk:í]	4th born male SG[20220704]
	d.	/nɛ̀kìk:í/	[nɛ̀kìk:í]	4th born male PL[20220704]
	e.	/ànòkòrì/	[ànògòrì]	eat 1SG[20220915_1]
	f.	/mànòk:òrì/	[mànòk:òrì]	sharp 3SG.F[20220915_1]
	g.	/kòrì/	[kòrì]	food SG[20220915_1]
	h.	/kòrì/	[gòrì]	eat IMP[20220915_1]

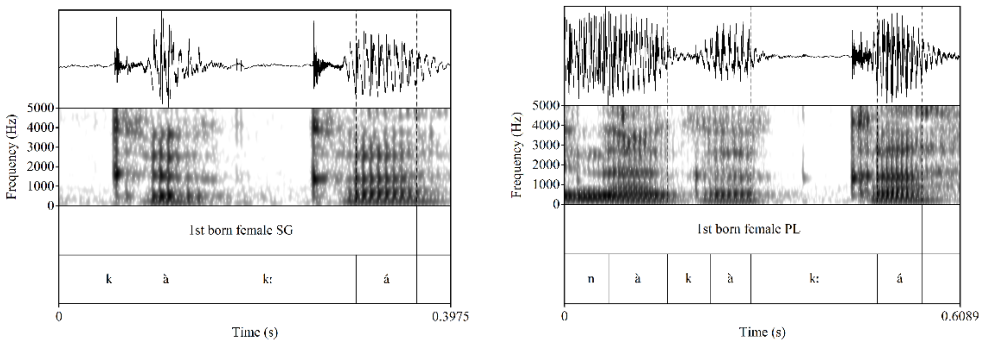

Figure 4-5.a: : Spectrograms and waveforms showing examples of the short velar plosive /k/ in word initial and intervocalic position due to pluralisation, respectively realised as [k] and [g]. The spectrograms and wave forms also show examples the long voiceless velar plosive /k:/ remaining as a geminate through morphophonological processes, with a closure duration of 180ms in the disyllabic singular noun form and 195ms in the trisyllabic plural noun form.

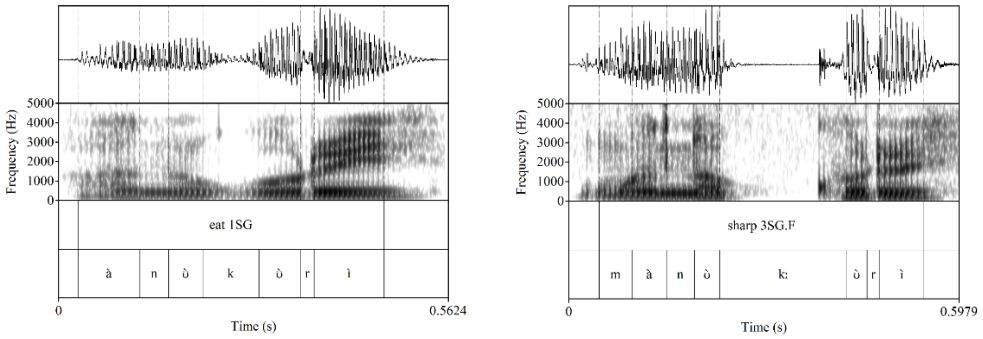

Figure 4-5.b: Spectrograms and waveforms showing examples of the short velar plosive /k/, which is realised as the voiced velar plosive [g] intervocalically with a closure duration of 81ms, contrasting with the long voiceless velar plosive /k:/, which has a closure duration of 194ms.

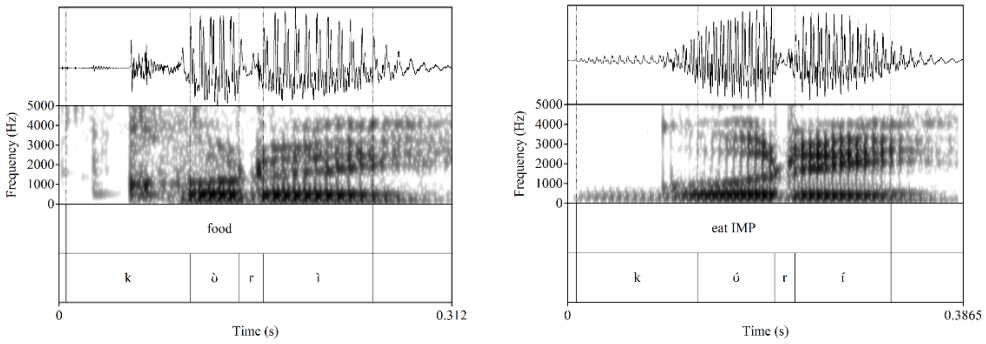

Figure 4.5-c: Spectrograms and waveforms showing examples of the short velar plosive /k/ in word initial position with different realisations. /k/ is realised as the voiceless velar plosive [k] word initially in the noun 'food', but is realised as the voiced velar plosive [g] word initially for the imperative verb form 'Eat!', which is likely caused by the loss of an initial V- syllable historically, observed by comparing the data collected for the current project and the transcription by Schadeberg (1994) for other Kadu languages.

The intensification process, which is found to change the short retroflex plosive that is voiced intervocalically to the long voiceless retroflex plosive, appears to similarly extend the length of the long voiceless velar plosive /k:/, for example in Example 4-5.i compared to Example 4-5.j. There is not enough evidence suggesting that [k::], the lengthened realisation of the voiceless geminate /k:/, is a contrastive phoneme.

(4-5) i. /àɓòk:é/ [àɓòk:ê] big[20221006]

j. /àɓòk::é/[1] [àɓòk::ê] big INT[20221006]

/ʔ/

The glottal stop occurs word-medially, either intervocalically or preceding other consonants, for example respectively in (4-6.a) and (4-6.b), with their waveforms and spectrograms shown in Figure 4-6.a.

(4-6) a. /àʔà/ [àʔà] I(1SG)[20221014]

b. /às:íʔɲà/ [àʃ:íʔɲà] small[20221006]

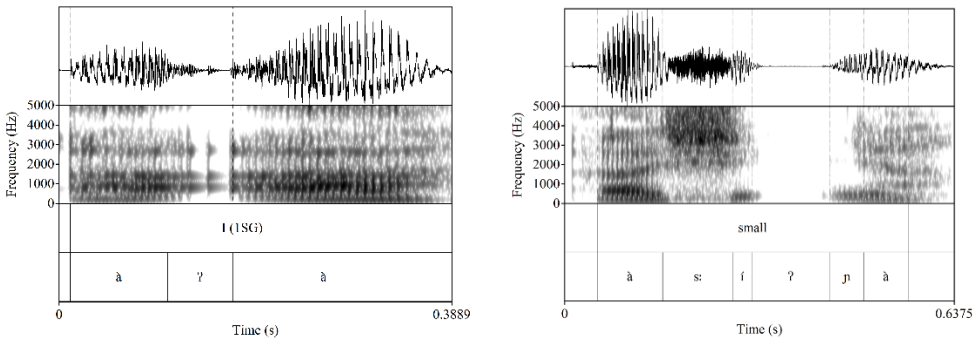

Figure 4-6.a: Spectrograms and waveforms showing examples of the glottal stop in intervocalic position, and in word medial position between a vowel and a consonant.

The intensification process, which is discussed for the retroflex plosives and the long voiceless velar plosive, can also affect the glottal stop, where the closure

[1] There is no evidence that [k::] is a contrastive phoneme. The 'phonemic' transcription here is presented for contrast between the intensified and non-intensified forms.

duration is extended, for example in Example 4-6.c compared to Example 4-6.d and in Figure 4-6.b.

Like the further lengthened long voiceless velar stop [kː], it is unclear whether the lengthened glottal stop [ʔː] is phonemic.

(4-6)	c.	/àsːíʔŋà/	[àʃːíʔŋà]	small[20221006]
	d.	/àsːíʔːŋà/[2]	[àʃːíʔːŋà]	small INT[20221006]

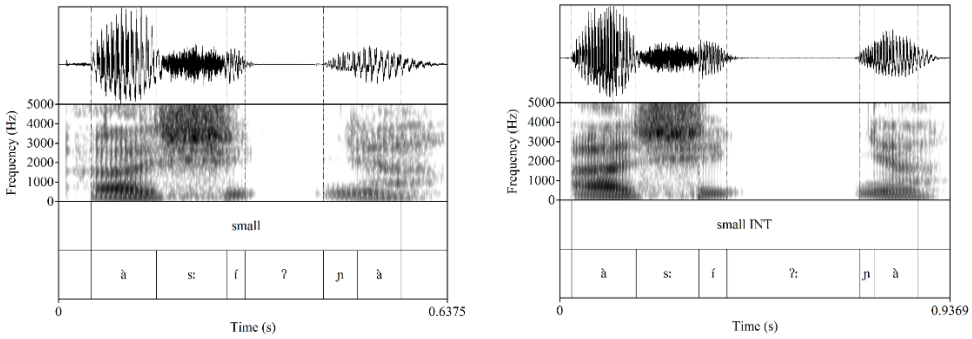

Figure 4-6.b: Spectrograms and waveforms showing examples of the transformation from /ʔ/ (closure duration: 128ms) to [ʔː] (closure duration: 319ms) in intensification.

[2] There is no evidence that [ʔː] is a contrastive phoneme. Again, the 'phonemic' transcription here is presented for contrast between the intensified and non-intensified forms.

4.2.2 Fricatives

/f/ & /f:/

There are two contrastive labio-dental fricatives, /f/ and /f:/. The place of articulation of the labial fricatives is disputed in previous studies. Based on what is observed in the present study, the labial fricatives are labio-dental instead of bilabial.

The short labio-dental fricative /f/ can occur in both initial and medial positions. Like the short plosives, the singleton labio-dental fricative /f/ is realised as and the voiced labio-dental fricative [v] between voiced segments, and as the voiceless labio-dental fricative [f] otherwise. The voicing of the word initial /f/ in morphophonological processes such as pluralisation is presented in Example 4-7.a, where /f/ is realised as [f] in word initial position in the singular noun form, compared to Example 4-7.b, where /f/ is instead realised as [v] intervocalically in the plural noun form, since a CV- prefix is added during pluralisation, with corresponding waveforms and spectrograms presented in Figure 4-7.a. While rare, [v] does sometimes occur word in word initial position, specifically for the prepositional particle ‘like’ [va] (Example 4-7.e), likely because this particle always follows other Kufo words which favour open syllables, resulting in /f/ occurring in intervocalic positions due to its close connection with the last vowel of the preceding word.

The long labio-dental fricative /f:/ occurs intervocalically only and is always voiceless, and it is contrastive with /f/, for example in Example 4-7.c compared to Example 4-7.d and in Figure 4-7.b.

(4-7)	a.	/fá/	[fâ]	tree SG[20221021]
	b.	/ná:fá/	[ná:vá]	trees PL[20221021]
	c.	/n̪àfá/	[n̪àvá]	have INF[20220824]
	d.	/n̪àf:á/	[n̪àf:â]	crawl INF[20220824]
	e.	/fá/	[vá]	like PREP [20220824]

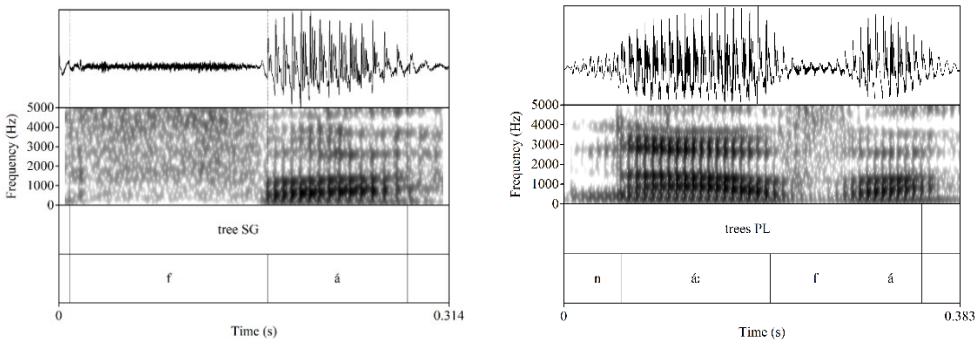

Figure 4-7.a: Spectrograms and waveforms showing examples of the short labio-dental fricative /f/ in word initial position (left) and intervocalic position (right) due to pluralisation.

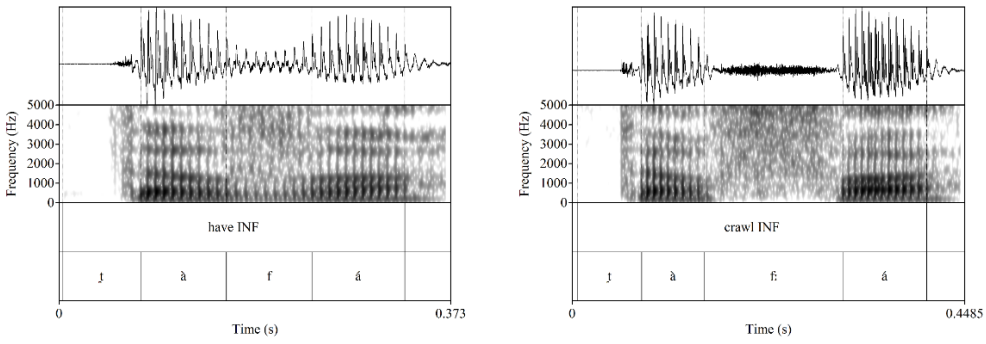

Figure 4-7.b: Spectrograms and waveforms showing examples of the short labio-dental fricative /f/ (left), which is realised as the voiced labio-dental fricative [v] in intervocalic position with a duration of 82ms, contrasting with the long voiceless labio-dental fricative /f:/ (right), which has a duration of 158ms.

/s/ & /sː/

There are two contrastive coronal fricative phonemes, /s/ and /sː/.

/s/ occurs both word initially and medially, and its place of articulation is affected by the neighbouring vowels. Between voiced segments, /s/ is voiced, either realised as the voiced postalveolar fricative [ʒ] when neighbouring /i, iː, ɪ, ɪː/ or as the voiced alveolar fricative [z] otherwise. When not occurring between voiced segments, /s/ is voiceless, either realised as the voiceless postalveolar fricative [ʃ] when preceding close or near close front vowels /i, iː, ɪ, ɪː/ or as the voiceless alveolar fricative [s] otherwise. Like the velar plosive /k/, the voicing of the intervocalic coronal fricatives appears to be unstable, since [ʃ] occasionally occurs intervocalically, for example in Example 4-8.g, where normally the phoneme would be realised as [ʒ] in Example 4-8.e. Furthermore, similar to the labio-dental fricative /f/ [v], the voiced alveolar fricative [z] is also found to occur word-initially in one lexeme, ‘hessian vine SG’ /zúkú/ [zúgú], which might again be caused by the loss of an initial V- or CV- syllable, as is discussed for the word initial voiced short velar plosive /k/ [ɡ] in the imperative verb form ‘Eat!’. The voiced alveolar fricatives are also found word initially in a few imperative verb forms, and it appears that accompanying the loss of the initial CV- or V- syllable, the vowel quality and its influence might be lost as well in some Kufo dialects, for example the imperative form of the verb ‘chop’ /tàsáːná/ is [ʒáːná] in East Kufo and [záːná] in Mid Kufo. Haroun reports that old generations in East Kufo would pronounce the imperative form as [ìʒáːná]. This raises the question of what the base form of Kufo verbs is, and how vowels in initial syllable of infinitive verbs might have been centralised or lost over time.

/sː/ occurs intervocalically only and is always voiceless. The place of articulation of /sː/, like its short counterpart /s/, is affected by the neighbouring vowels. /sː/ is generally realised as the long voiceless alveolar fricative [sː] but is realised as the long voiceless postalveolar fricative [ʃː] when neighbouring /i, iː, ɪ, ɪː/.

The participant in this study reports that the retraction of /s/ to [ʃ] before close front vowels is a dialectal difference. In East Kufo, where Haroun comes from, this process occurs, whereas in Mid Kufo, this process is reported to not exist. Moreover, the only counterexample for coronal fricative retraction near close front vowels in Kufo noted by Schadeberg (1994), 'night' *albɔɔsini*, is found to be produced as the postalveolar fricative in the present data, /ʈàlɓɔ́ːsìnì/ [ʈàlɓɔ́ːʒìnì]. Furthermore, the postalveolar affricate, which is only reported by Dafalla (2006), is found in one lexical item only in the current data (Example 4-8.h), and Haroun suggests that this is a word that originally had a postalveolar fricative but has been changed under the influence of the Arab nomads who pass through the region and borrowed this word. There is not enough evidence to suggest that the postalveolar affricate is a contrastive phoneme.

(4-8)	a.	/sʊ́lɛ́/	[sʊ́lɛ́]	eggs PL[20221021]
	b.	/ʈʊ̀nsʊ́lɛ́/	[ʈʊ̀nzʊ́lɛ́]	egg SG[20221021]
	c.	/ʈɛ̀ːsɛ́/	[ʈɛ̀ːzɛ́]	filter SG[20220506]
	d.	/ʈás:ɛ̀/	[ʈás:ɛ̀]	k.o. tattoo SG[20220824]
	e.	/kìsì/	[kìʒì]	rocks PL[20220824]
	f.	/kís:í/	[kíʃːí]	guts PL[20220824]

g.	/kìsì/	[kìʃì]	rocks PL[20220824]
h.	/ɓɔ́ʃːà/[3]	[ɓɔ́tʃà]	everyday[20220908_6]

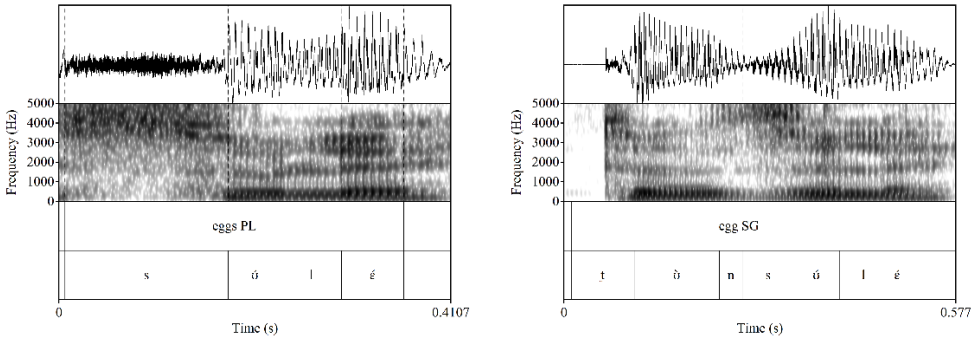

Figure 4-8.a: Spectrograms and waveforms showing examples of the short alveolar fricative /s/ in word initial position (left) and between voiced segments due to singularisation (right). Word initially, the short alveolar fricative /s/ is realised as the voiceless alveolar fricative [s] since it is not neighbouring any close front vowel. Between voiced segments, /s/ experiences voicing and is realised as the voiced alveolar fricative [z].

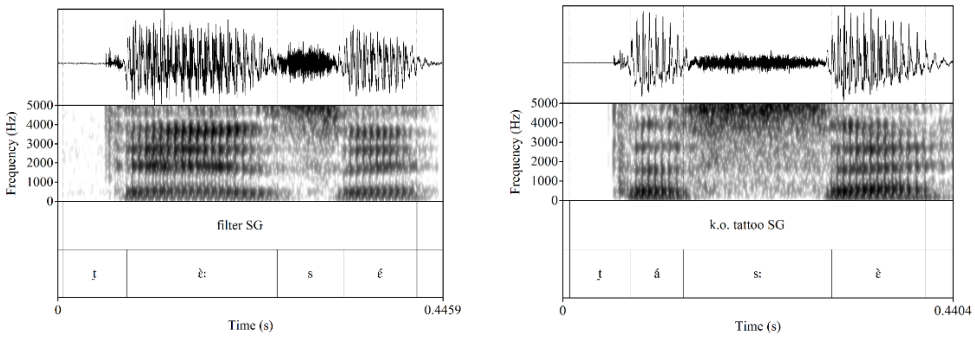

Figure 4-8.b: Spectrograms and waveforms showing examples of the short alveolar fricative /s/ (left), which is realised as the voiced alveolar fricative [z] with a duration of 77ms, contrasting with the long voiceless alveolar fricative /s:/ (right), which has a duration of 168ms.

[3] There is no evidence that [tʃ] or [ʃː] are contrastive phonemes. The 'phonemic' transcriptions here are used to represent the one lexical item where the affricate occurs and how it is perceived by the speaker.

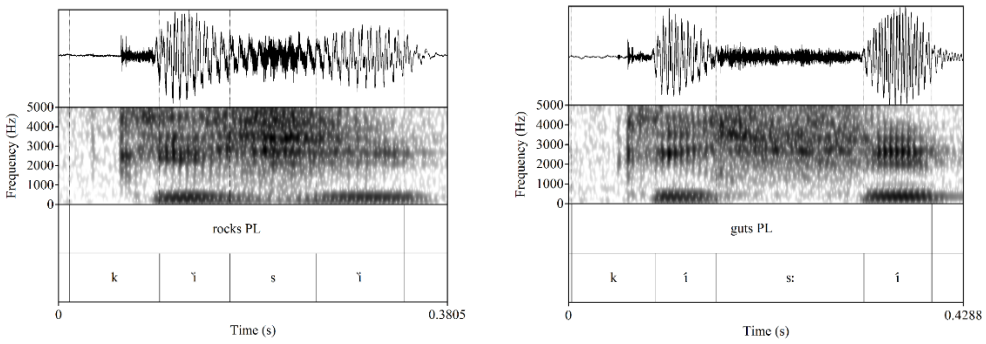

Figure 4-8.c: Spectrograms and waveforms showing examples of retraction of the short alveolar fricative /s/ (left) and the long alveolar fricative /s:/ (right) intervocalically neighbouring close front vowels. The short alveolar fricative /s/ is retracted and realised as the voiced postalveolar fricative [ʒ] with a duration of 85ms, whereas the long voiceless alveolar fricative /s:/ is retracted as well and realised as the long voiceless postalveolar fricative [ʃ:] with a duration of 160ms.

4.2.3 Nasals

/m/

The bilabial nasal /m/ can occur in word initial, medial, and final positions, for example respectively in Example 4-9.a, Example 4-9.b, and Example 4-9.c. /m/ contrasts with the bilabial plosives and labio-dental fricatives, as can be seen intervocalically in Example 4-9.b compared to Examples 4-1.c.d.e and Examples 4-7.c.d.

(4-9)	a.	/mùsó/	[mùzó]	flour PL[20220506]
	b.	/n̪à:mà/	[n̪à:mà]	lost[20220818_3]
	c.	/kàcàm/	[kàɲàm]	trap[20221021]

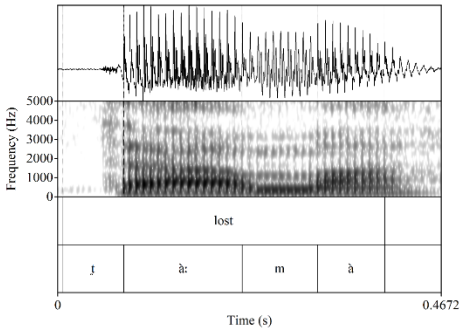

Figure 4-9: Spectrogram and waveform showing an example of the bilabial nasal /m/ in intervocalic position, with a duration of 92ms.

/n/ & /n:/

The alveolar nasals /n/ and /n:/ exhibit a length contrast. The short alveolar nasal /n/ occurs in initial, medial, and final positions, for example in Example 4-10.a.b.d. The long alveolar nasal /n:/ appears intervocalically only and contrasts with /n/, as can be seen in Example 4-10.b compared to 4-10.c and Figure 4-10.a. /n/ and /n:/ contrast with the dental /t̪/, as can be seen intervocalically in Examples 4-10.b.c.e.

(4-10)	a.	/níːsò/	[níːzò]	hands PL[20221021]
	b.	/t̪àná/	[t̪àná]	buy INF[20220818_3]
	c.	/t̪ànːà/	[t̪ànːà]	stay INF[20220818_3]
	d.	/kàɾàkàn/	[kàɾəgàn]	jaundice[20221021]
	e.	/t̪àːt̪à/	[t̪àːd̪à]	grandmother SG[20220811]

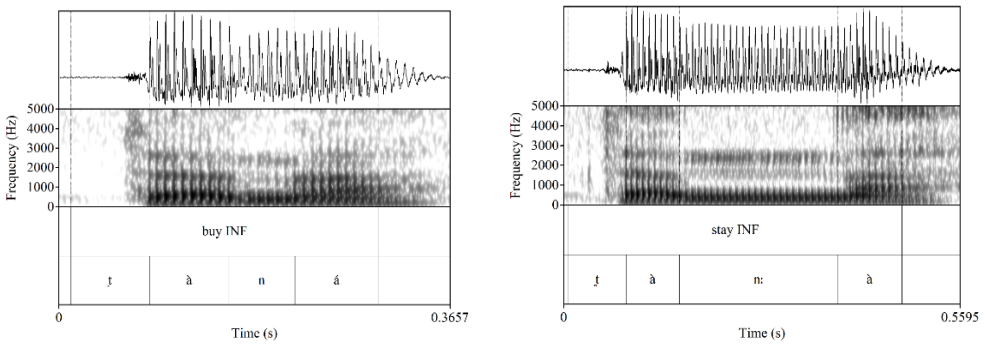

Figure 4-10.a: Spectrograms and waveforms showing examples of the short alveolar nasal /n/ (left), which has a duration of 62ms, contrasting with the long alveolar nasal /n:/ (right), which has a duration of 223ms intervocalically in disyllabic words.

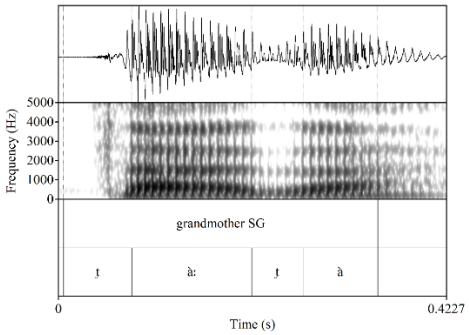

Figure 4-10.b: Spectrogram and waveform showing an example of the dental plosive /t̪/ in intervocalic position, realised as the voiced dental plosive [d̪].

/ɲ/ & /ɲː/

The short and long palatal nasals /ɲ/ and /ɲː/ are laminal coronal consonants. The short palatal nasal /ɲ/ occurs in initial, medial, and final positions, for example respectively in Example 4-11.a, Example 4-11.b, and Example 4-11.d, whereas the long nasal /ɲː/ occurs intervocalically only and contrasts with its short counterpart /ɲ/ and the palatal plosive, as can be seen in Example 4-11.b compared to Example 4-11.c compared to Example 4-11.e as well as in Figure 4-11.a and Figure 4-11.b.

(4-11)	a.	/ɲé:ké/	/ɲé:gé/	mosquitoes PL[20220506]
	b.	/t̪ì̪ɲá/	[t̪ì̪ɲá]	smell INF[20221006]
	c.	/t̪ì̪ɲ:à/	[t̪ì̪ɲ:à]	wind[20221006]
	d.	/kɾá:ɲ/	[kɾá:ɲ]	hyena SG[20221014]
	e.	/t̪ìcá/	[t̪ì̪ɟá]	milk INF[20220811]

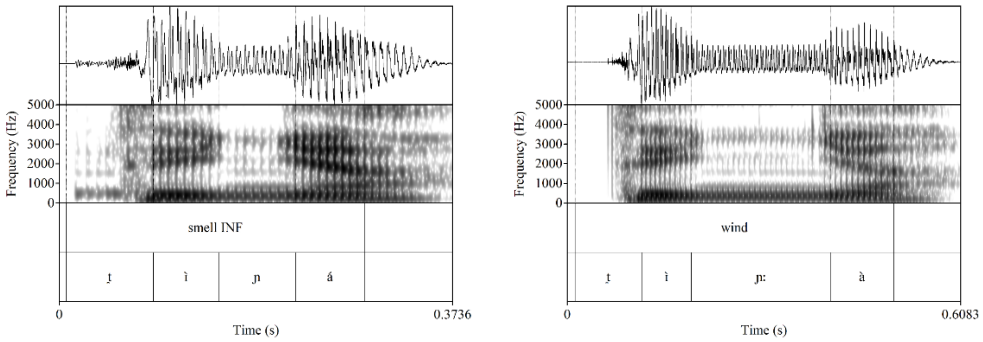

Figure 4-11.a: Spectrograms and waveforms showing examples of the short palatal nasal /ɲ/ (left), which has a duration of 73ms, contrasting with the long palatal nasal /ɲ:/ (right), which has a duration of 216ms, both intervocalically in disyllabic words.

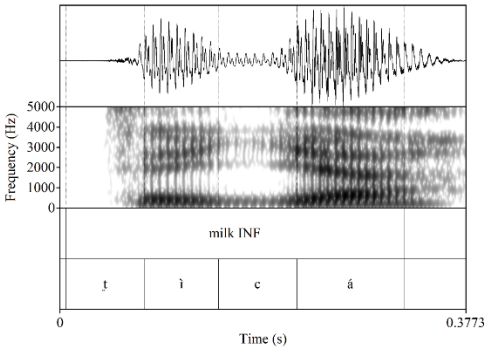

Figure 4-11.b: Spectrogram and waveform showing an example of the short palatal plosive /c/ in intervocalic position, realised as the voiced palatal plosive /ɟ/.

/ŋ/

The velar nasal /ŋ/ can occur in word initial and medial positions, for example respectively in Example 4-12.a and Example 4-12.b. /ŋ/ contrasts with the velar plosive /k/, as can be seen in Example 4-12.b compared to Example 4-12.c and in Figure 4-12.a. /ŋ/ it is not yet found to occur in word final position like other nasals. Moreover, based on data collected for the current project, /ŋ/ does not appear to exhibit a length contrast as is reported by Hall & Hall (2004); the lexemes they give as examples for this are not produced as long vs. short, as shown in Example 4-12.d and Example 4-12.e.

(4-12)	a.	/ŋò/	[ŋò]	1PL.EXCL[20221021]
	b.	/máŋà/	[máŋà]	POSS 1PL.INCL[20221021]
	c.	/má:ká/	[má:gá]	POSS 2PL[20221021]
	d.	/fáŋá/	[fáŋá]	shed SG[20220908_5]
	e.	/ɓáŋá/	[ɓáŋá]	aardvark SG[20220908_5]

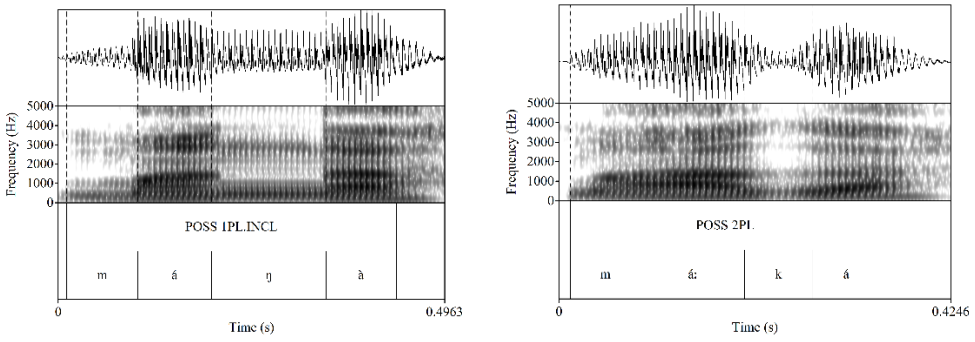

Figure 4-12.a: Spectrograms and waveforms showing examples of velar nasal /ŋ/ (left) contrasting with the velar plosive /k/ (right), which is realised as the voiced velar plosive [g], intervocalically in disyllabic words.

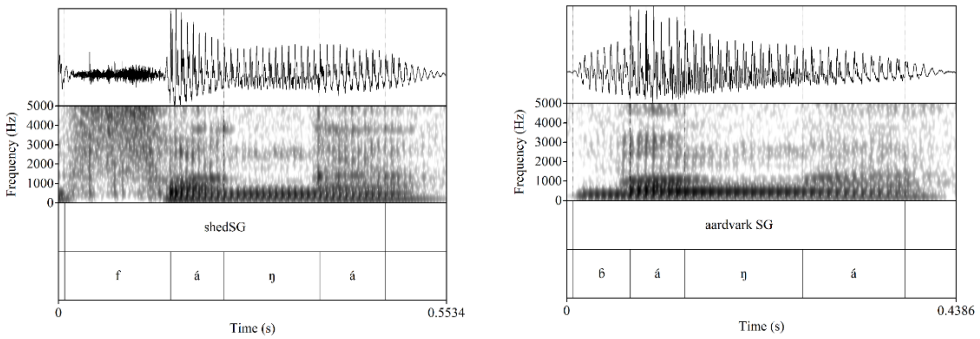

Figure 4-12.b: Spectrograms and waveforms showing examples of the velar nasal /ŋ/ in intervocalic position, with a duration of 137ms (left) and 133ms (right). These two words are examples supporting the proposed length contrast for velar nasals in Kufo by Hall & Hall, and the velar nasal does not appear to have a length contrast in the data collected for the current study.

4.2.4 Liquids

/ɾ/ & /r/

The alveolar tap /ɾ/ occurs in word initial and medial positions, as can be seen in Example 4-13.a and Example 4-13.b, whereas the alveolar trill /r/ is found in intervocalic position only and contrasts with /ɾ/, for example intervocalically in Example 4-13.b compared to Example 4-13.c and Figure 4-13, where /ɾ/ is extremely short and /r/ exhibits repeating closures over a longer duration.

(4-13)	a.	/ɾíjé/	[ɾíjé]	brother SG[20221014]
	b.	/t̪àrá/	[t̪àɾá]	collect INF[20220824]
	c.	/t̪àrá/	[t̪àrá]	care INF[20220824]

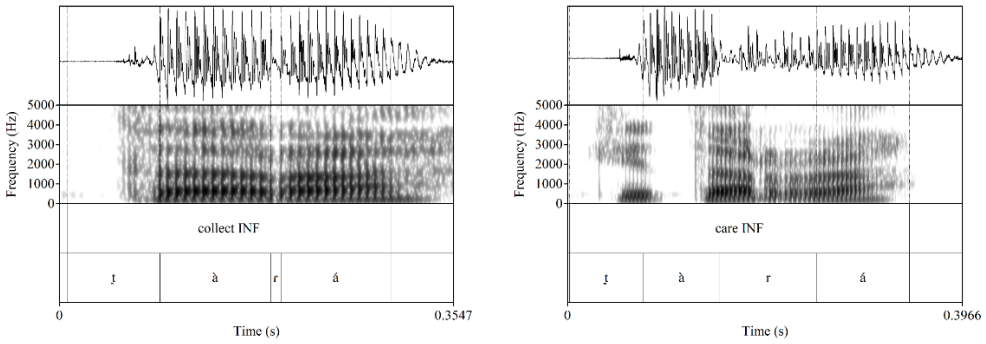

Figure 4-13: Spectrograms and waveforms showing examples of the alveolar tap /ɾ/ (left), which has a duration of 9ms, contrasting with the alveolar trill /r/ (right), which has a duration of 97ms, intervocalically in disyllabic words.

/l/ & /l:/

The short alveolar lateral /l/ occurs in word initial and medial positions, as can be seen respectively in Example 4-14.a and Example 4-14.b, whereas the long alveolar lateral /l:/ appears intervocalically only and contrasts with its short counterpart /l/, for example in Example 4-14.b compared to Example 4-14.c and Figure 4-14.a.

(4-14)	a.	/lí:lí/	[lí:lí]	unbearable heat[20220506]
	b.	/t̪à:lá/	[t̪à:lá]	separate INF[20220824]
	c.	/t̪àl:á/	[t̪àl:á]	stingy[20220824]

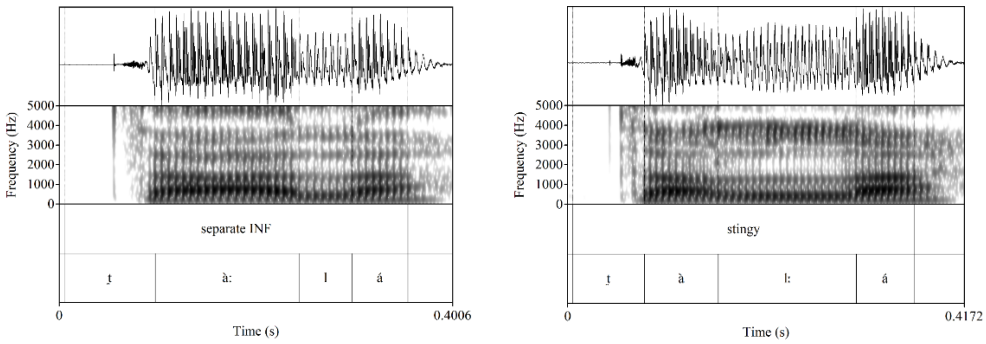

Figure 4-14.a: Spectrograms and waveforms showing examples of the short alveolar lateral /l/ (left), which has a duration of 54ms, contrasting with the long alveolar lateral /l:/ (right), which has a duration of 145ms, intervocalically in disyllabic words.

The intensification process appears to sometimes extend the length of the long alveolar lateral /l:/, for example in Example 4-14.d compared to Example 4-14.e. Again, there is not enough evidence suggesting that the further lengthened long alveolar lateral [l::] is phonemic.

(4-14)	d.	/t̪àl:ù/	[t̪àl:ù]	nice[20220908_2]
	e.	/t̪àl::ù/[4]	[t̪àl::ù]	nice INT[20220908_2]

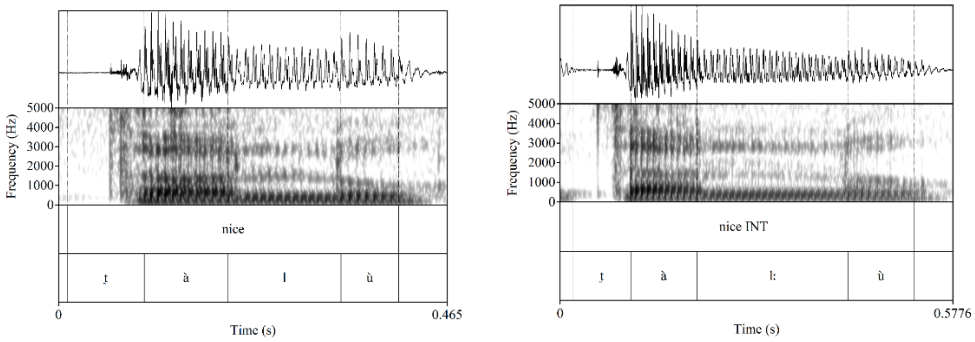

Figure 4-14.b: Spectrograms and waveforms showing examples of transformation from /l:/ (left) with a duration of 135ms compared to [l::] (right) with a duration of 222ms in intensification.

[4] There is no evidence that [l:] is a contrastive phoneme. Again, the 'phonemic' transcription here is presented for contrast between the intensified and non-intensified forms.

4.2.5 Glides

/w/

The labial-velar glide /w/ is contrastive with consonants of the same places of articulation, for example intervocalically in (4-15.b) compared to bilabial plosives in (4-1), labio-dental fricatives in (4-7), and velar plosives in (4-12.b).

(4-15) a. /wá:nɛ̀/ [wá:nɛ̀] go IMP[20221021]

b. /ʈáwá/ [ʈáwá] dew PL[20220824]

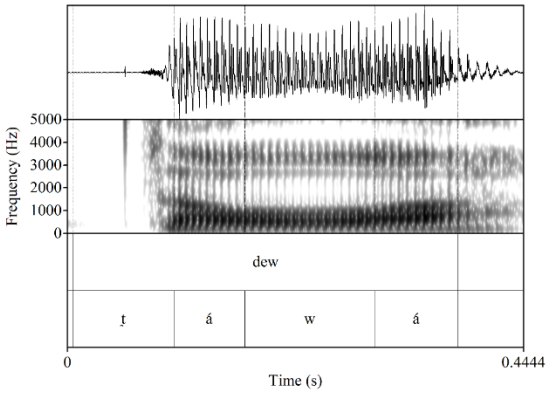

Figure 4-15: Spectrogram and waveform showing an example of the labial-velar glide /w/ in intervocalic position.

/j/ & /j:/

The short palatal glide /j/ can occur in word initial and medial positions, as is shown in Example 4-16.a and Example 4-16.b. Comparatively, the long palatal glide /j:/ occurs intervocalically only, like all other Kufo geminates. The short and long palatal glides contrast, for example in Example 4-16.b compared to Example 4-16.c, and they contrast with the palatal plosive in Example set 4.3.

(4-16) a. /jùkì/ [jùgì] wife SG[20221021]

b. /ájá/ [ájá] grasses PL[20220824]

c. /áj:à/ [áj:à] mother SG[20220824]

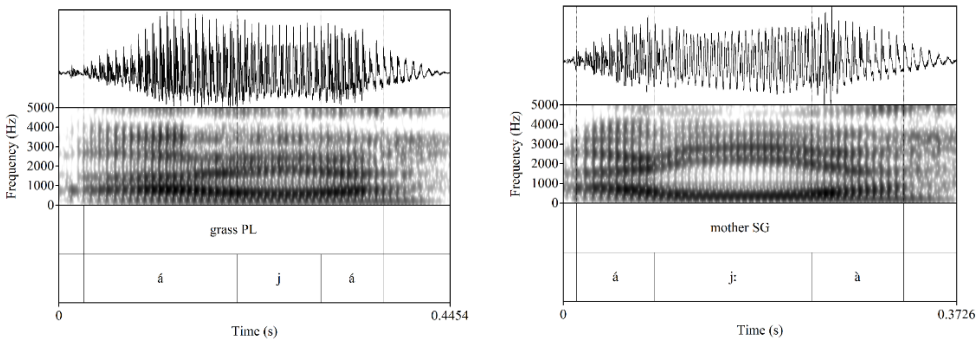

Figure 4-16: Spectrograms and waveforms showing examples of the short palatal glide /j/, which has a duration of 95ms, contrasting with the long palatal glide /j:/, which has a duration of 149ms, both occurring intervocalically in disyllabic words.

4.3 Phonotactics

As noted in Section 2.2, there is no general discussion on phonotactics in previous studies of Kufo and related language varieties, except a few features regarding the prenasalisation or nasal-stop sequences. This section will introduce the word structure and syllable structure of Kufo.

4.2.1 Word structure

The word structure in Kufo is closely related to its morphosyntax. Kufo is an SVO language, and detailed discussion of inflectional and derivational morphology awaits to be explored (Mullan, 2022, in prep.) and is beyond the scope of this project. However, a few grammatical features of Kufo will be briefly introduced in order to better discuss the phonological characteristics.

In the present data, words of up to five syllables are attested, but words of 2-3 syllables are more usual, and words with CV.CV and CV.CV.CV patterns are most common. Nouns stems in Kufo generally have two or three syllables, but monosyllabic stems are also found in the current data. Kufo noun stems generally have a default number, which is either singular or plural, and thus they can be either pluralised or singularised in morphological processes. The inflectional plural forms of Kufo nouns are often generated by adding a *na-* prefix, whereas the inflectional singular forms of Kufo nouns are often realised by adding a prefix which is a syllabic nasal or a syllabic nasal followed by a CV-prefix. Kufo verbs and adjectives can be derived from the nouns, and verbs and adjectives are inflected by person, number, and gender of their subjects, as well as time, aspect, and mood. Like the noun stems, verb and adjective stems in Kufo, are also often disyllabic or trisyllabic. The infinitive verb form is generally realised by adding a *tV-* prefix onto the noun stem, and the imperative verb form is often realised by removing the *t-* or *tV-* prefix of the corresponding infinitive verb form. Kufo adjectives can experience intensification, which as discussed has various forms of realisation; it is possible that intensification arises from historical change, e.g., deletion of a medial vowel, or compensatory lengthening, but there is no direct evidence available at this stage to shed light on the origin of intensification.

4.2.2 Syllable structure

The maximal syllable structure is presented below, with C and V respectively represent a consonant and a vowel.

(C)(C)V(C)

Various syllable types are possible in Kufo, and the five syllable types observed in the current data are shown in Table 4-2 with examples.

Table 4-2: Kufo syllable types with examples.

syllable type	example		
V	/à/	[à]	I
C	/m̩.n̪à.kɛ́ː.ɾú/	[m̩.n̪à.gɛ́ː.ɾú]	porcupine SG
VC	/úŋ.kú/	[úŋ.gú]	hyena SG
CV	/ŋò/	[ŋò]	1PL.EXCL
CVC	/n̪án.sú.lè/	[n̪án.zú.lè]	egg SG
CCV	/kwɛ́/	[kwɛ́]	axe SG
CCVC	/kɾáːɲ/	[kɾáːɲ]	hyena SG

As is shown in examples throughout Section 4.2, all consonants can occur in word medial position; they can also all occur as syllable onsets, though not word-initially for the geminates and the glottal stop. The syllable types presented in Table 4-2 include syllabic nasals, syllables with onset clusters, and closed syllables. Syllabic nasals often occur in singularised noun forms in Kufo. Onset clusters are uncommon in Kufo, and only two types of onset clusters have been found in the data collected for the current project, including /kɾ/ where an alveolar tap follows a short velar plosive, and /kw/ where a labial-velar glide follows a short velar plosive. Syllable codas are rare as well, and the only consonant phonemes that can be codas in Kufo are nasals at bilabial, alveolar, and palatal places of articulation, though some plosives and fricatives are found in word final position in loan words from Arabic.

Regarding the syllabic nasals, the idea of nasal-stop sequences or prenasalisation, as discussed in Section 2.2, has been proposed in previous studies for Kufo and related language varieties. Based on data collected for the current study, the nasal and oral that occur consecutively in word initial positions are not always homorganic, since sequences like *m̩t̪a-* and *n̩t̪a-* are both found in the singularisation process of nouns, as can be seen in Example 4-17.c compared to Example 4-17.d and Example 4-17.e compared to Example 4-17.f. Since Kufo verbs are often derived from nouns, the process where the verbs often lose the vowel in their initial syllable, for example in Example 4-17.a compared to Example 4-17.b, where the open central vowel /a/ in the initial syllable of the verb is lost, and this process may as well have been applied to the nouns in an earlier historical stage.

(4-17)	a.	/á nàt̪ːáná/	[á nàt̪ːáná]	I buy 1SG FUT[20220714]
	b.	/ànt̪ːáná/	[ànt̪ːáná]	I buy 1SG FUT[20220714]
	c.	/kɛ́ːɾú/	[kɛ́ːɾú]	porcupines PL[20221014]
	d.	/m̩t̪àkɛ́ːɾú/	[m̩t̪àgɛ́ːɾú]	porcupine SG[20221014]
	e.	/wí/	[wí]	birds PL[20221014]
	f.	/n̩t̪úwí/	[n̩d̪úwí]	bird SG[20221014]

4.3 Acoustic phonetic evidence: plosives

4.3.1 Materials

Based on the descriptive phonological data leading up to the current study, auditory impressions are that in Kufo, pulmonic plosives occur at bilabial, dental,

retroflex, palatal, velar, and glottal places of articulation, while implosives only occur at bilabial and alveolar places of articulation. The short pulmonic plosives are generally voiced between voiced segments and voiceless otherwise, the long pulmonic plosives occur intervocalically only and are always voiceless, and the implosives are contrastive with the pulmonic plosives.

In order to examine the voicing and length characteristics of plosives more closely, a wordlist was developed for target consonants in word medial position in disyllabic words with a CVCV structure. This wordlist was compiled based on elicitations sessions in mid 2022 (Li, 2022), and all words in this wordlist were elicited five times consecutively in the frame 'I say … today' / àʔà nìkːí ... ɓìt̪ːènɪ/. Ideally, all target consonants would be best placed in word initial position, but this is not applicative, given that the long voiceless geminates occur intervocalically only. Target consonants include the short and long bilabial plosives /p, pː/, the short and long dental plosives /t̪, t̪ː/, the short and long retroflex plosives /ʈ, ʈː/, the palatal plosive /c/, the short and long velar plosives /k, kː/, as well as the bilabial and alveolar implosives /ɓ, ɗ/. The consonant closure was segmented based on the offset of periodicity of the preceding vowel and the release burst, and voice onset time was also annotated on a separate tier. In total, this phonetic database consists of 178 occurrences of 36 target words, and the number of tokens of each plosive is presented below in Table 4-3. The number of tokens of each plosive is unbalanced, given the limited lexical data available for Kufo at this stage.

Table 4-3: Number of tokens in the plosive dataset.

pulmonic			non-pulmonic		
phoneme	phone	#	phoneme	phone	#
/p/	[bː]	10	/ɓ/	[ɓ]	31
/pː/	[pː]	5			
/t̪/	[d̪]	30	/ɗ/	[ɗ]	5
/t̪ː/	[t̪ː]	21			
/ʈ/	[ɖ]	3			
/ʈː/	[ʈː]	5			
/c/	[ɟ]	10			
/k/	[g]	15			
/kː/	[kː]	43			

4.3.2 Results

The results for plosive closure duration measurements are presented in Table 4-4 and Figure 4-17. For plosives at the bilabial place of articulation, the bilabial implosive /ɓ/ has the shortest average duration of 74ms, whereas the mean duration of /p/ [bː] and /pː/ [pː] are respectively 125ms and 116ms. For anterior coronal plosives, /t̪/ [d̪] and /ɗ/ have shorter durations of 73ms and 64ms, which are approximately half as long as the duration of /t̪ː/ [t̪ː],127ms. For the retroflex plosives, the average duration measurements of /ʈ/ [ɖ] and /ʈː/ [ʈː] are respectively 75ms and 138ms. The palatal plosive /c/ is 68ms, which is within a similar range as other short consonants. For the velar plosives, the mean duration of /k/ [g] is 68ms, whereas the mean duration of /kː/ [kː] is 137ms.

Table 4-4: Mean and standard deviation for closure duration (ms) of word-medial plosives.

pulmonic				non-pulmonic			
phoneme	phone	mean	sd	phoneme	phone	mean	sd
/p/	[bː]	125	9	/ɓ/	[ɓ]	74	19
/pː/	[pː]	116	14				
/ʈ/	[ɖ]	73	8	/ɗ/	[ɗ]	64	3
/ʈː/	[ʈː]	127	16				
/ʈ/	[ɖ]	75	21				
/ʈː/	[ʈː]	138	17				
/c/	[ɟ]	68	8				
/k/	[g]	68	14				
/kː/	[kː]	137	20				

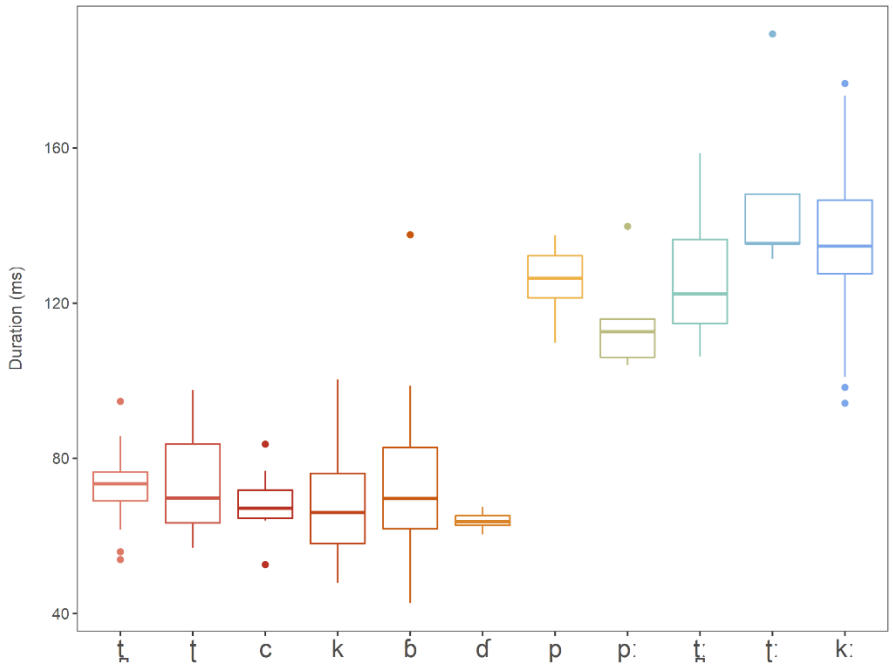

Figure 4-17: Closure duration of word-medial plosives.

The results for plosive voice onset time (VOT) measurements are presented in Table 4-5 and Figure 4-18. Since the short pulmonic plosives and the implosives are found to be consistently voiced between voiced segments, their voice onset time, which is negative, has the same value as their duration which has been presented in Table 4-4. Comparatively, the long pulmonic plosives, which are always voiceless despite the environment, have positive voice onset times. The average voice onset time is 29ms for the long voiceless bilabial plosive /pː/, 42ms for the long voiceless dental plosive /t̪ː/, 53ms for the long voiceless retroflex plosive /ʈː/, and 48ms for the long voiceless velar plosive /kː/.

Table 4-5: Mean and standard deviation for voice onset time (ms) of word-medial plosives.

pulmonic				non-pulmonic			
phoneme	phone	mean	sd	phoneme	phone	mean	sd
/p/	[bː]	-125	9	/ɓ/	[ɓ]	-74	19
/pː/	[pː]	29	4				
/t̪/	[d̪]	-73	8	/ɗ/	[ɗ]	-64	3
/t̪ː/	[t̪ː]	42	7				
/ʈ/	[ɖ]	-93	23				
/ʈː/	[ʈː]	53	6				
/c/	[ɟ]	-68	8				
/k/	[g]	-68	14				
/kː/	[kː]	48	12				

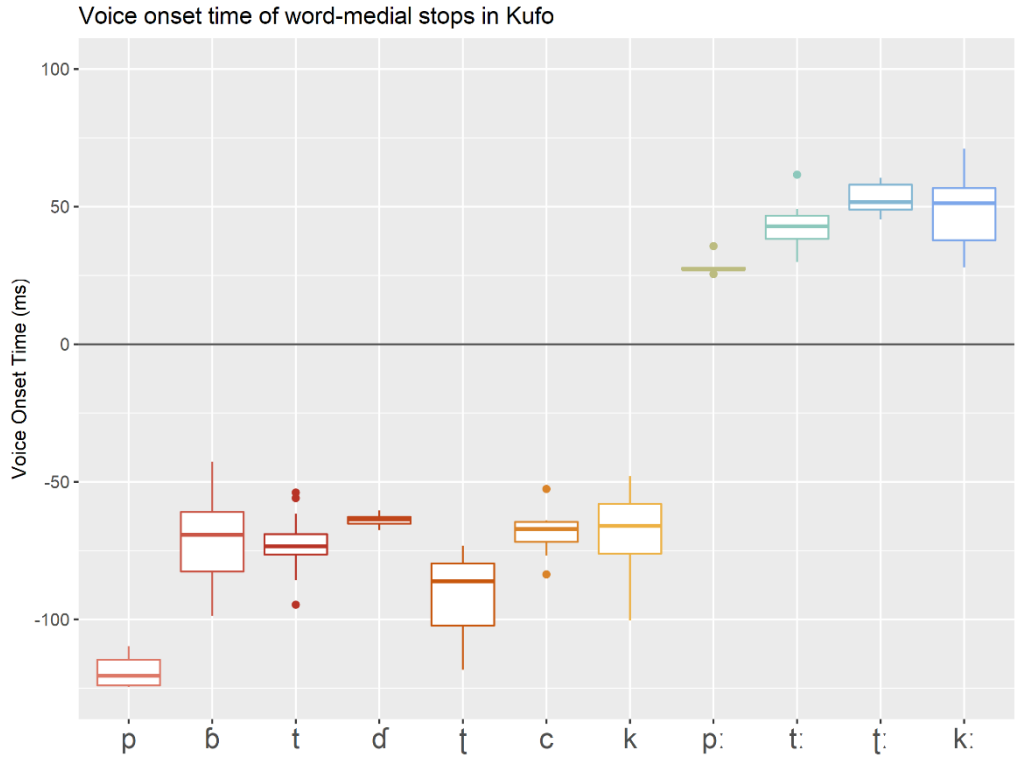

Figure 4-18: Voice onset time of word-medial plosives.

4.4 Discussion

Kufo has 30 contrastive consonant phonemes which appear to have eight places of articulation including bilabial, labio-dental, dental, alveolar, retroflex, palatal, velar, and glottal, and six manners of articulation including pulmonic plosive, implosive, fricative, nasal, liquid, and glide. Some Kufo sonorants have a length contrast, and the plosives and fricatives exhibit interesting laryngeal, airstream, and length features. These consonantal phonemic contrasts are supported by descriptive phonological evidence as well as acoustic phonetic results.

Chapter 5 Vowels

5.1 Introduction

This chapter seeks to develop the description of the Kufo vowel system based on phonological evidence and analyses of the acoustic and durational characteristics of vowels. Section 5.2 introduces Kufo vowel phonemes regarding vowel quality and vowel length. Section 5.3 presents the results of the two phonetic analyses of vowels, with the first examining vowel quality and length and the second focusing on the central vowels. The examples presented in this chapter are included in Appendix E.

5.2 Vowel phonemes

Based on the present data, Kufo has 18 contrastive vowel phonemes. The Kufo vowel inventory is presented in Table 5-1. The 18 vowel phonemes belong to nine contrastive vowel qualities that exhibit a length contrast, where each vowel quality has a short and a long vowel phoneme. Possible vowel sequences or diphthongs, which were shown in Dafalla's (2006) transcription, were checked in this study, and they appear to be either long monophthongs or vowel+glide+vowel sequences. No diphthongs or vowel sequences are found in the data collected for the present study.

The Kufo vowel phonemes will be introduced grouped by vowel qualities of similar roundness, backness, and openness in the sections below. Based on the data collected for the present study, there is a tendency for vowels of the same putative ATR category (discussed further in Section 5.3) to co-occur within the

same root, but there is no evidence that this this process happens in inflected forms as well.

Table 5-1: Kufo vowel inventory.

	front	central	back
close	/i, iː/		/u, uː/
near-close	/ɪ, ɪː/		/ʊ, ʊː/
close-mid	/e, eː/		/o, oː/
mid			
open-mid	/ɛ, ɛː/		/ɔ, ɔː/
open		/a, aː/	

/i, iː/ & /ɪ, ɪː/

The close front unrounded vowels /i, iː/ and the near-close front unrounded vowels /ɪ, ɪː/ are contrastive, as can be seen in initial syllables of disyllabic words for the short vowels in Example 5-1.a compared to Example 5-1.b and Figure 5-1.a, and for the long vowels in Example 5-1.c compared to Example 5-1.d and Figure 5-1.b. In disyllabic words, which this study has mainly been collecting, the long close and near-close front vowels /iː, ɪː/ have the tendency to occur in initial syllables, whereas their short counterparts /i, ɪ/ frequently occur in both syllables.

True minimal pairs for the vowel length contrast are rare across all vowel qualities. Examples of the length contrast for the short and long near-close front

vowels /ɪ, ɪː/ are presented in Example 5-1.e compared to Example 5-1.f and in Figure 5-1.c.

(5-1)	a.	/kìkːí/	[kìkːí]	4th born male SG[20220506]
	b.	/kìkːí/	[kìkːí]	4th born female SG[20220506]
	c.	/líːlí/	[líːlí]	unbearable heat[20220506]
	d.	/líːlí/	[líːlí]	money[20220506]
	e.	/sìkà/	[ʃìgà]	farm SG[20220506]
	f.	/síːká/	[ʃíːgá]	milk PL[20220506]

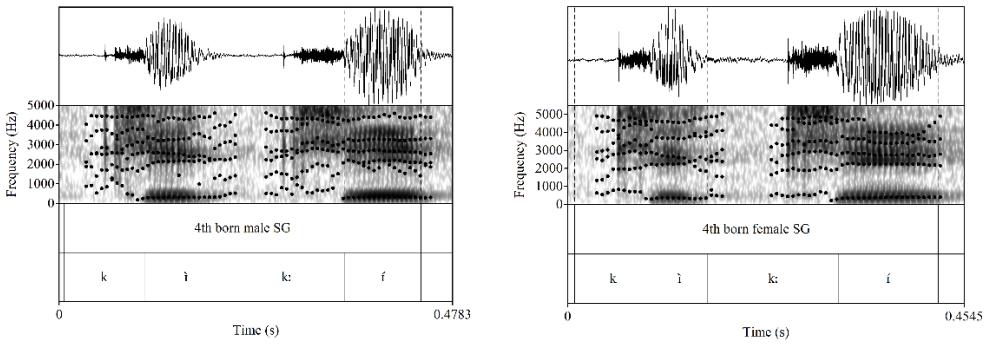

Figure 5-1.a: Spectrograms and waveforms showing examples of the short close front unrounded vowel /i/ (left) compared to the short near-close front unrounded vowel /ɪ/ (right).

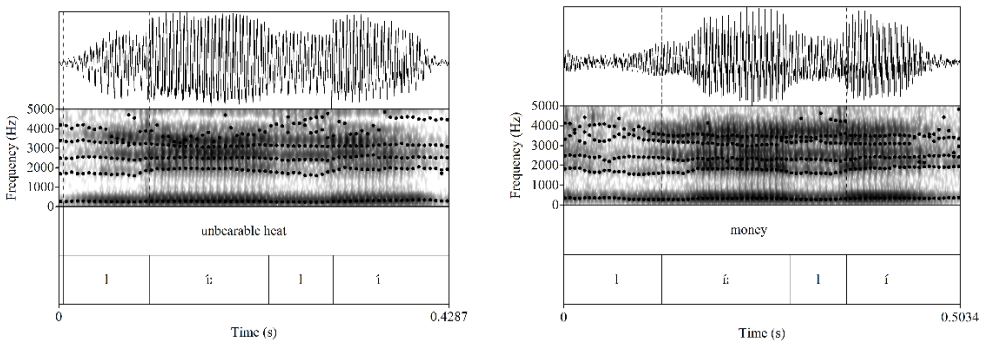

Figure 5-1.b: Spectrograms and waveforms showing examples of the long close front unrounded vowel /iː/ (left) compared to the long near-close front unrounded vowel /ɪː/ (right), in initial syllables of disyllabic words.

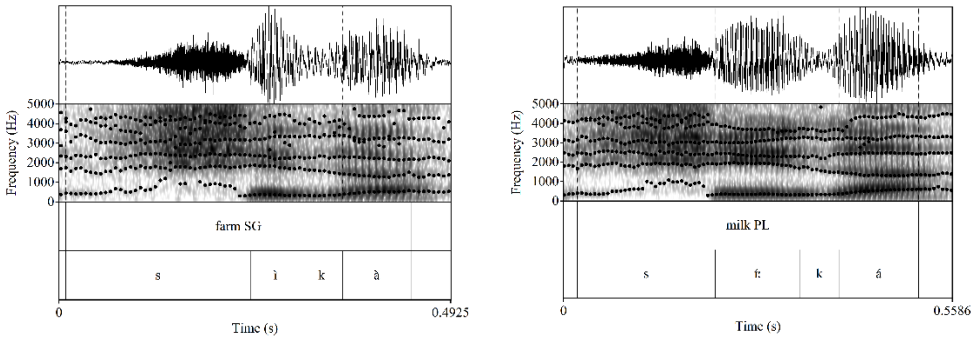

Figure 5-1.c: Spectrograms and waveforms showing examples of the length contrast of the short near-close front vowels /ɪ/ (left) with a duration of 63ms and long near-close front vowel /ɪː/ (right) with a duration of 122ms.

/e, eː/ & /ɛ, ɛː/

The close-mid front unrounded vowels /e, eː/ and the open-mid front unrounded vowels /ɛ, ɛː/ are contrastive, as can be seen in Example 5-2.a compared to Example 5-2.b and Figure 5-2.a. In disyllabic words, the long close-mid and open-mid front unrounded vowels /eː, ɛː/ appear mostly occur in the initial syllables, whereas their short counterparts /e, ɛ/ occur more often in final syllables than in initial syllables. In languages with an 'Advanced Tongue Root' distinction, a matter returned to for Kufo in section 5.3, the close-mid front unrounded vowels /e, eː/ and the near-close front unrounded vowels /ɪ, ɪː/ are often reported to be difficult to distinguish for non-native ears (Casali, 2008, pp. 508–510), which is also the case for Kufo. However, phonological evidence suggests that these two vowel qualities do contrast, as can be seen in Example 5-2.c compared to Example 5-2.d and in Figure 5-2.b.

(5-2)	a.	/cé:né/	[ɟé:né]	clean IMP[20220506]
	b.	/cɛ́:nɛ́/	[cɛ́:nɛ́]	wake up IMP[20220915_4]
	c.	/ʈ̪ìcá/	[ʈ̪ìɟá]	milk INF[20220811]
	d.	/ʈ̪ècá/	[ʈ̪èɟá]	awake INF[20220811]

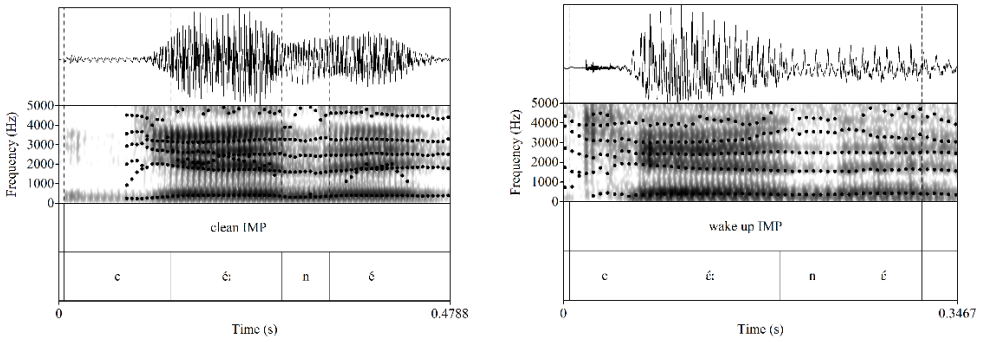

Figure 5-2.a: Spectrograms and waveforms showing examples of the close-mid front unrounded vowels /e, e:/ (left) contrasting with the open-mid front unrounded vowels /ɛ, ɛ:/ (right).

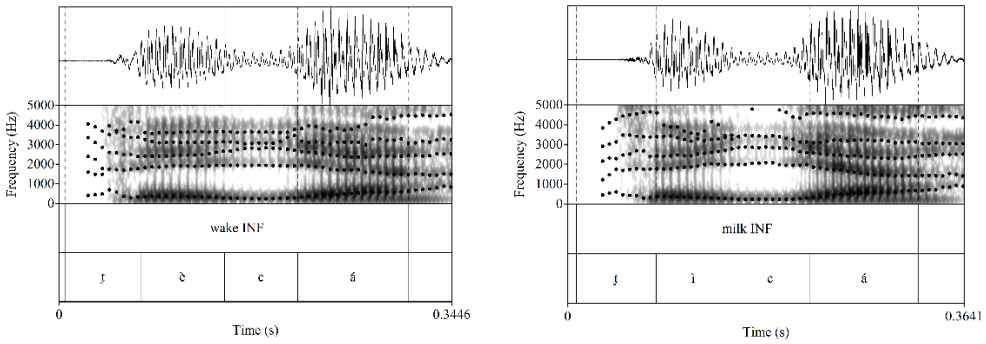

Figure 5-2.b: Spectrograms and waveforms showing examples of the close-mid front unrounded vowel /e/ (left) contrasting with the near-close front unrounded vowel /ɪ/ (right).

/o, o:/ & /ɔ, ɔ:/

The close-mid back rounded vowels /o, o:/ and the open-mid back rounded vowels /ɔ, ɔ:/ are contrastive, as can be seen for the short vowels in Example 5-

3.a compared to Example 5-3.b and in Figure 5-3, and for the long vowels in Example 5-3.c compared to Example 5-3.d. In disyllabic words, the long close-mid back rounded vowel /oː/ and the long open-mid back rounded vowel /ɔː/ generally occur in initial syllables, whereas their short counterparts /o, ɔ/ often occur in both syllables.

(5-3)	a.	/t̪òkːò/	[t̪òkːò]	scrape INF[20220811]
	b.	/t̪ɔ̀kːɔ̀/	[t̪ɔ̀kːɔ̀]	scratch INF[20220811]
	c.	/t̪óːɾó/	[t̪óːɾó]	bull SG[20220704]
	d.	/kɔ́ːlɔ́/	[kɔ́ːlɔ́]	valley SG[20220506]

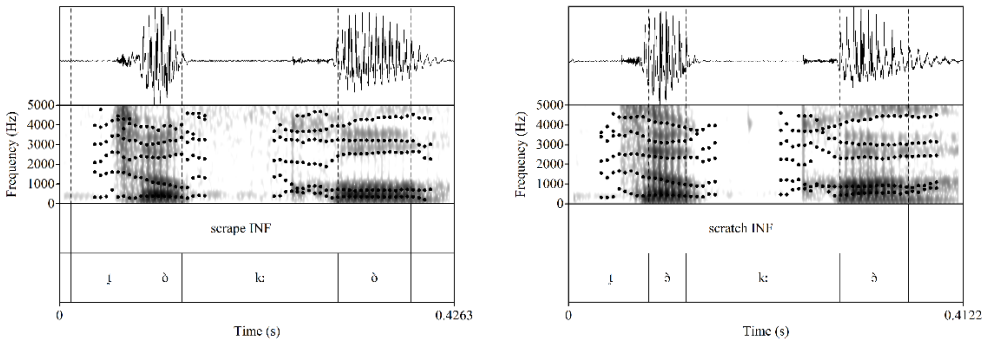

Figure 5-3: Spectrograms and waveforms showing examples of the contrast between the close-mid back rounded vowel /o/ (left) and the open-mid back rounded vowel /ɔ/ (right).

/u, uː/ & /ʊ, ʊː/

The close back rounded vowels /u, uː/ and the near-close back rounded vowels /ʊ, ʊː/ are contrastive, as can be seen in Example 5-4.a compared to Example 5-4.b. In disyllabic words, the long close back rounded vowel /uː/ and the long near-close back rounded vowel /ʊː/ appear much less frequently than other vowel

phonemes, and when they do occur, it is always in the final syllables, for example in Example 5-4.c and Example 5-4.d. Comparatively, the short close back rounded vowel /u/ and the short near-close back rounded vowel /ʊ/ can occur in both syllables.

Like the close-mid front unrounded vowels /e, eː/ and the near-close front unrounded vowels /ɪ, ɪː/, the close-mid back rounded vowels /o, oː/ and the near-close back rounded vowels /ʊ, ʊː/ can be difficult to distinguish for learners of Kufo. The contrast between these two vowel qualities is supported by phonological evidence, for example in Example 5-4.a compared to Example 5-4.b and in Figure 5-4.

(5-4)	a.	/t̪ùkːù/	[t̪ùkːù]	drive INF[20220811]
	b.	/t̪ùkːò/	[t̪ùkːò]	write INF[20220811]
	c.	/t̪òfːùː/	[t̪òfːùː]	hessian[20221014]
	d.	/kát̪óː/	[kád̪óː]	people[20221014]

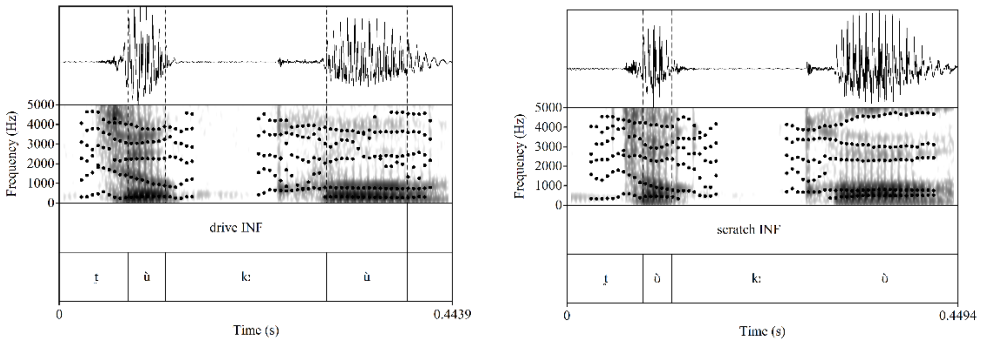

Figure 5-4: Spectrograms and waveforms showing examples of the contrast between the close back rounded vowel /u/ (left) and the near-close back rounded vowel /ʊ/ (right).

/a, aː/

The short and long open central vowels /a, aː/[5] contrast with the other vowel phonemes. In disyllabic words, the short open central vowel /a/ frequently occurs in both syllables (Example 5-5.a), whereas the long open central vowel /aː/ is often found in initial syllables (Example 5-5.b). /a/ is found word-initially in a small number of nouns and is often found as the prefix for third person masculine singular conjugations for many verbs. The short and long open central vowels are contrastive, as can be seen in Example 5-5.c compared to Example 5-5.d and in Figure 5-5.a. Based on auditory impressions, the short open central vowel /a/ often sounds more centralised than its long counterpart /aː/, especially in multisyllabic words in naturalistic speech, for example the short open central vowel /a/ is reduced to [ə] in the third syllable of Example 5-5.e and Figure 5-5.b; this reduction can also be observed for /a/ in initial syllables of Example 5-5.c and Example 5-5.d.

(5-5)	a.	/fádə̀/	[fádə̀]	cave SG[20220506]
	b.	/káːsá/	[káːzá]	broom PL[20220704]
	c.	/t̪àsànà/	[t̪àzànà]	spray INF[20221021]
	d.	/t̪àsáːná/	[t̪àzáːná]	chop INF[20221021]
	e.	/nàkáŋkàsàlà/	[nàgáŋgəzàlà]	priests PL[20221021]

[5] These symbols are used here to indicate an open central vowel with the quality [ɐ], as is often the case in descriptive works.

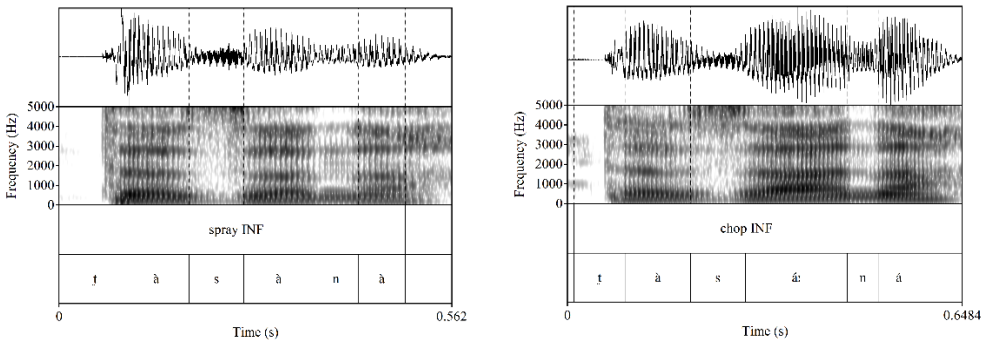

Figure 5-5.a: Spectrograms and waveforms showing examples of the length contrast between the short open central vowel /a/ (left) with a duration of 100ms and the long open central vowels /a:/ (right) with a duration of 167ms, in the second syllables of trisyllabic words.

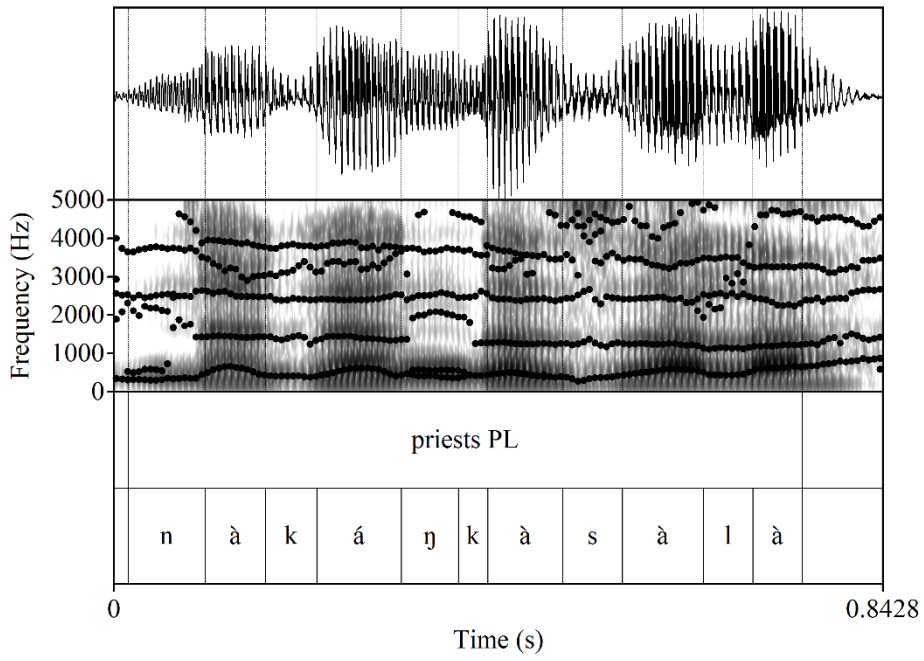

Figure 5-5.b: Spectrograms and waveforms showing an example of the /a/ reduced as its allophone [ə] in the third syllable of a multisyllabic word, as evidenced by the lower first formant frequency for the vowel in the third syllable.

The intensification process appears to sometimes cause vowel lengthening, addition to the consonant lengthening discussed for the retroflex plosives, the long velar plosive, the glottal stop, and the long alveolar lateral in the preceding

chapter. As can be seen in Example 5-5.f compared to Example 5-5.g, the short open central vowel /a/ in the normal form is lengthened in the intensified form.

(5-5)	f.	/àsíkálà/	[àʒígálà]	long[20221006]
	g.	/àsíkáːlà/	[àʒígáːlà]	long INT[20221006]

5.3 Acoustic phonetic evidence: vowel quality and duration

5.3.1 Materials

Based on the descriptive phonological data leading up to the current study, auditory impressions are that there are 18 contrastive vowel phonemes (presented in Table 5-1), which are short and long vowel phonemes of 9 contrastive vowel qualities. There is also a phonetic mid central vowel quality [ə], which is likely an allophone of the open central vowel /a/, serving as its reduced form in certain phonological environment.

Based on this hypothesised vowel inventory, a wordlist was developed, consisting of 66 disyllabic words with a CVCV structure. This wordlist was compiled based on notes from the 2021 Field Methods course at the Australian national University (Carroll, 2021), follow-up elicitation sessions in early 2022 (Li, 2022), and the unpublished wordlist by Blench & Mongash (Blench & Mongash, 2022). The wordlist was finalised in consultation with the speaker in early 2022, with careful consideration to include all hypothesised vowel qualities. A balance across vowel qualities was aimed for as much as possible within the limitations of the small amount of available lexical data for the language. The CVCV words also included consonants of a range of places and manners of

articulation and had a range of tonal patterns. The items in the wordlist were arranged in a pseudo-random order to ensure that words with vowels of different qualities are evenly distributed throughout the wordlist. The wordlist of the vowel inventory database is presented in Appendix C.

The wordlist was arranged into Microsoft PowerPoint slides where each target word was presented with its English translation and an accompanying picture. The Kufo orthography was not included in the presentation, in order to avoid any influence of orthographic representations on the speaker's production. Additionally, the Kufo orthography is not yet fully developed, especially regarding the representation of the ATR feature, which is related to one of the aims of this chapter. All words in the wordlist were elicited five times consecutively in the frame 'I say … today' / àʔà nìkːí ... ɓìt̪ːènɪ/, in order to control for prosodic effects and provide a sufficient number of tokens for phonetic exploration.

Given that every word in the vowel database has a CVCV structure, all vowels occur in either word-medial or word-final position. Word-medial vowels were segmented based on the onset of periodicity after the preceding consonant, and the offset of periodicity before the following consonant. Word-final vowels were segmented based on the onset of periodicity after the preceding consonant, and either the offset of periodicity before the following bilabial implosive in the frame sentence, or, in cases where the target word is followed by a pause, based on the offset of periodicity and continuous formant structure (Croot et al., 1992).

Measures of first and second formant frequencies at vowel midpoints, and of vowel duration, were extracted and analysed for vowels in the target words. In total, this phonetic database consists of 333 occurrences of 66 target words. A total of 653 vowel tokens were analysed, including 328 vowels in the first syllable and 325 vowels in the second syllable. The number of tokens of each vowel is listed below in Table 5.2 according to the vowel quality (vq) and the syllable in which it occurs (s1 or s2 for first or second syllable). Short vowel tokens appear in both s1 and s2, whereas long vowel tokens appear in s1 only. There were thirteen 0 values for the second formant frequency measurement due to tracking errors, and these rows of data were removed from the dataset.

Table 5-2: Number of tokens in the vowel dataset.

vq	short		long	total	vq	short		long	total
	s1	s2	s1			s1	s2	s1	
i	35	51	20	106	ɪ	35	40	10	85
e	0	20	15	35	ɛ	0	34	29	63
o	25	60	20	105	ɔ	23	38	15	76
u	30	20	0	50	ʊ	34	25	0	59
					a	25	37	12	74

5.3.2 Vowel quality: first and second formant frequencies

The results for first and second formant frequency measurements based on vowel midpoints are displayed according to vowel quality in Table 5-3, Figure 5-6 with long and short vowels combined, and Figure 5-7 with long and short vowels separated.

Table 5-3: Mean and standard deviation for F1 and F2 (Hz) based on vowel midpoints.

vq	F1	sd	F2	sd	vq	F1	sd	F2	sd
i	314	24	2214	135	ɪ	356	24	2164	150
e	399	27	1951	66	ɛ	473	51	1804	85
o	420	40	946	88	ɔ	480	52	920	126
u	340	19	1046	292	ʊ	368	24	965	204
					a	570	74	1452	230

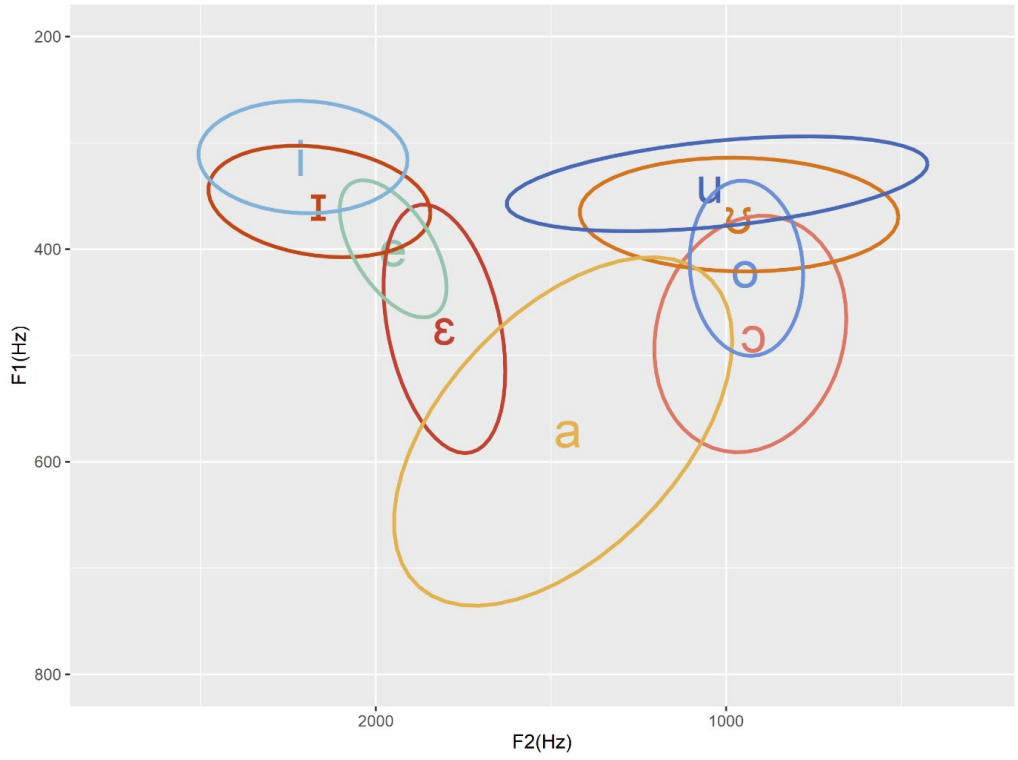

Figure 5-6: First and second formant frequency measurements, short and long vowels combined.

For the close and near-close front vowel qualities, the mean F1 for /i/ and /ɪ/ are respectively 312 Hz and 356 Hz. For the close-mid and mid front vowel qualities, the mean F1 for /e/ and /ɛ/ are respectively 399 Hz and 473 Hz. For the close and near-close back vowel qualities, the mean F1 for /u/ and /ʊ/ are respectively 340

Hz and 368 Hz. For the close-mid and open-mid back vowel qualities, the mean F1 for /o/ and /ɔ/ are respectively 420 Hz and 480 Hz. The near-open central vowel /a/ is distinct from the other vowel qualities and has a mean F1 of 570 Hz. There are no major F2 differences between pairs of similar vowels, though there are indications that the close-mid vowels may tend towards a more front quality than the open-mid vowels, e.g., the mean F2 of /e/ is 1951 Hz, which is higher than the mean F2 of /ɛ/, 1804 Hz.

The acoustic results provide some supporting evidence for an analysis of 9 contrastive vowel qualities in Kufo. While there is some overlap in the distributions for the vowel categories, the phonetic patterns accord with the current phonological hypothesis, and are also similar to vowel spaces for other 9-vowel systems with an Advanced Tongue Root contrast.

The mean F1 values for close and mid vowels also provide some supporting evidence for an ATR-type contrast, where the closer vowel in each pair, which is potentially categorised as the [+ATR] vowel, has a lower first formant frequency than its more open counterpart, which is potentially categorised as the [-ATR] vowel. The contrasts suggest that there are likely four [+/-ATR] vowel quality pairs in Kufo: /i/ and /ɪ/, /e/ and /ɛ/, /u/ and /ʊ/, and /o/ and /ɔ/.

As for the disputed central vowel, Figure 5-7 presents the distribution of long and short vowels, including those of the central vowel /a, aː/. It is clear that the short central vowel is more mid and has a wider range than its long counterpart, which is possibly an indication that [ə] is an allophone of /a/, which will be further discussed in Section 5.3.4. Regarding the database that is described in

Sections 5.3.1 and 5.3.2, the first and second formant frequency measurements of the short and long open central vowels /a, aː/ suggest that compared to /aː/, /a/ is more centralised, and has a wider range of distribution.

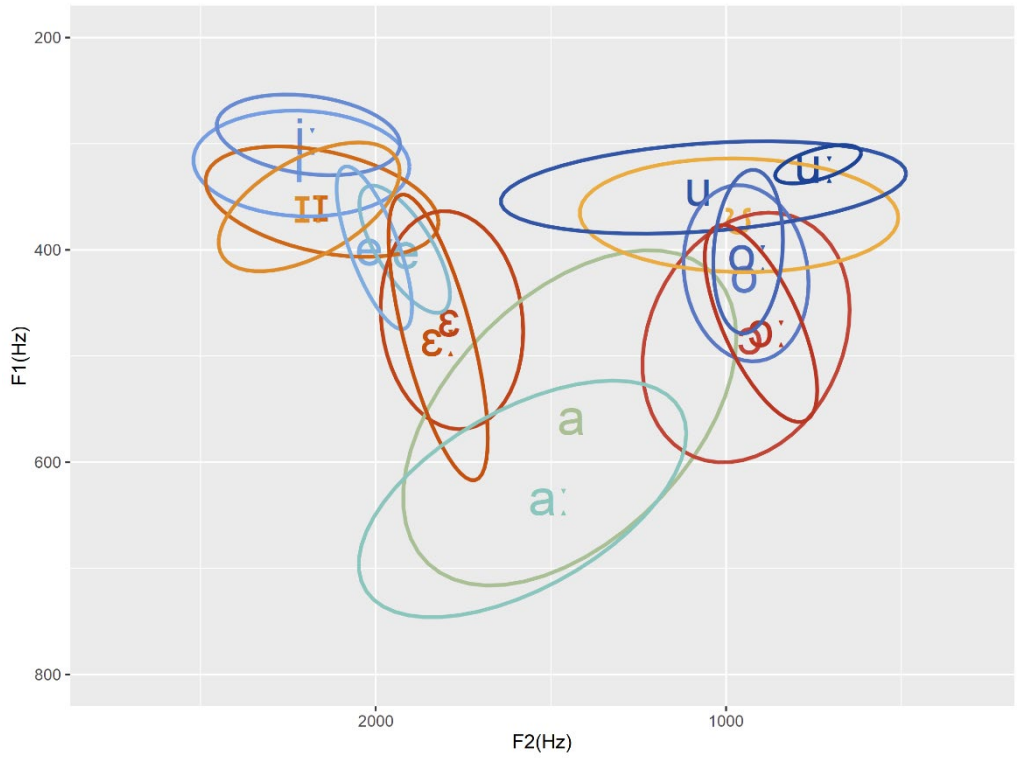

Figure 5-7: First and second formant frequency measurements, short and long vowels separated.

5.3.3 Vowel length: duration

The results for vowel duration measurements are presented in the following section, in Table 5-6 and Figure 5-8. Only the durations of vowels in the first syllables of target words are shown here, given that, as noted for the different vowel qualities in Section 5.2, this is the environment where there is the most evidence for the length contrast.

Table 5-4: Mean and standard deviation for duration (ms) for vowels in initial syllables.

v	dur	sd	v	dur	sd	v	dur	sd	v	dur	sd
i	67	8	iː	134	14	ɪ	69	15	ɪː	130	16
e	-	-	eː	146	25	ɛ	-	-	ɛː	158	15
o	82	17	oː	145	13	ɔ	81	17	ɔː	151	17
u	67	14	uː	-	-	ʊ	69	12	ʊː	-	-
						a	79	10	aː	157	27

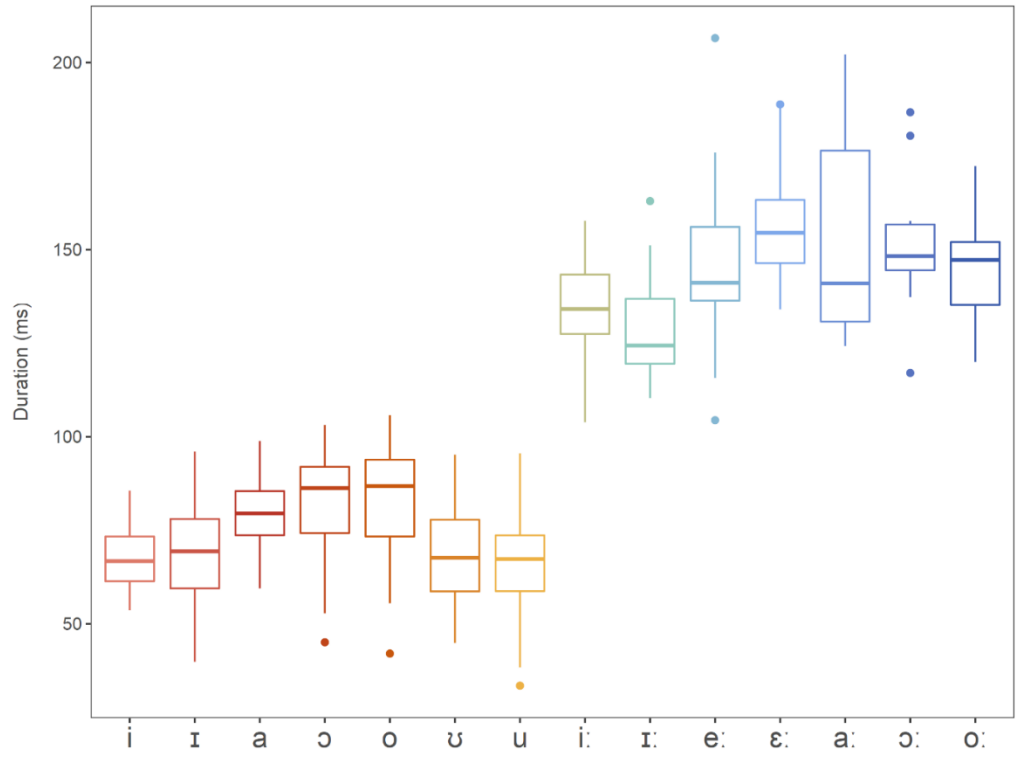

Figure 5-8: Vowel duration of vowels in initial syllables.

For the close front vowels, the mean duration of the short vowel /i/ and the long vowel /iː/ are respectively 67 msec and 134 msec. For the near-close front vowels, the mean duration of the short vowel /ɪ/ and the long vowel /ɪː/ are respectively 69 msec and 130 msec. For the open central vowels, the duration of the short

vowel /a/ and the long vowel /aː/ are respectively 79 msec and 157 msec. For the open-mid back vowels, the duration of the short vowel /ɔ/ and the long vowel /ɔː/ are respectively 81 msec and 151 msec. For the close-mid back vowels, the duration of the short vowel /o/ and the long vowel /ɔː/ and respectively 82 msec and 145 msec. Across all vowel qualities, short vowels are on average 73 msec and long vowels are on average 146ms, therefore exactly twice as long.

The duration measures in the first syllable suggests that five vowel qualities exhibit a length contrast, including /i, iː/, /ɪ, ɪː/, /a, aː/, /o, oː/, and /ɔ, ɔː/, and phonological evidence across syllables indicates that /e, eː/ and /ɛ, ɛː/ also contrast in length. As shown in Figure 5-8, the duration of the Kufo vowels also displays a pattern where the closer vowels have shorter durations compared to the more open vowels, as is common crosslinguistically (Maddieson, 1997).

As can be observed from the results, the durations of /u/ and /ʊ/ are in a similar range to the durations for short vowels where long counterparts are established, so it is likely that these two vowel phones can be categorised as phonemically short. As noted in Section 5.2, long /uː/ and /ʊː/ occur very infrequently and, unlike other long vowels, only occur in the second syllable of disyllabic words, so the durational evidence for the length contrast could not be directly tested with the data discussed here.

5.3.4 The central vowel

Some further investigation of the central vowels was undertaken, following the differing observations noted in Section 2.4 on whether *schwa* is a contrastive

phoneme, and the results above showing that the short open central vowel /a/ is more centralised than its long counterpart /a:/.

A small database was built to examine the central vowels in Kufo, based on the graphemic distinction between <a> and <ax> presented in the Kufo alphabet book (Kafi & Mongash, 1998). The wordlist is presented in Appendix D. The words containing <a> /a/ were collected in interview sessions for this project therefore have phonemic and phonetic transcriptions and have a CVCV word structure as described in Section 5.3.1, whereas the words containing <ax> are found in the Kufo alphabet book (Kafi & Mongash, 1998) with orthographic transcriptions only, and their corresponding vowel quality is unclear. The words with <ax> have 1-3 syllables and a range of consonant surrounding the open vowel of interest.

The results are presented in Table 5-5 and Figure 5-9. For the vowel represented by the grapheme <a>, the mean first and second formant frequency measurements are respectively 491Hz and 1412Hz. For the vowel represented by the grapheme <ax>, the mean first and second formant frequency measurements are respectively 369Hz and 1365Hz. The ranges of the two vowel qualities considerably overlap in Figure 5-9, though <a> has a wider range in F1 while <ax> has a wider range in F2. Based on this, there does not appear to be clear evidence that <ax> corresponds to a distinct vowel quality, and it is possible that it has more in common with the centralised realisations of /a/ discussed in Section 5.2.

Table 5-5: Central vowel F1 F2 measurements, mean and standard deviation (Hz).

grapheme	F1	sd	F2	sd	grapheme	F1	sd	F2	sd
a	491	126	1412	94	ax	368	123	1365	196

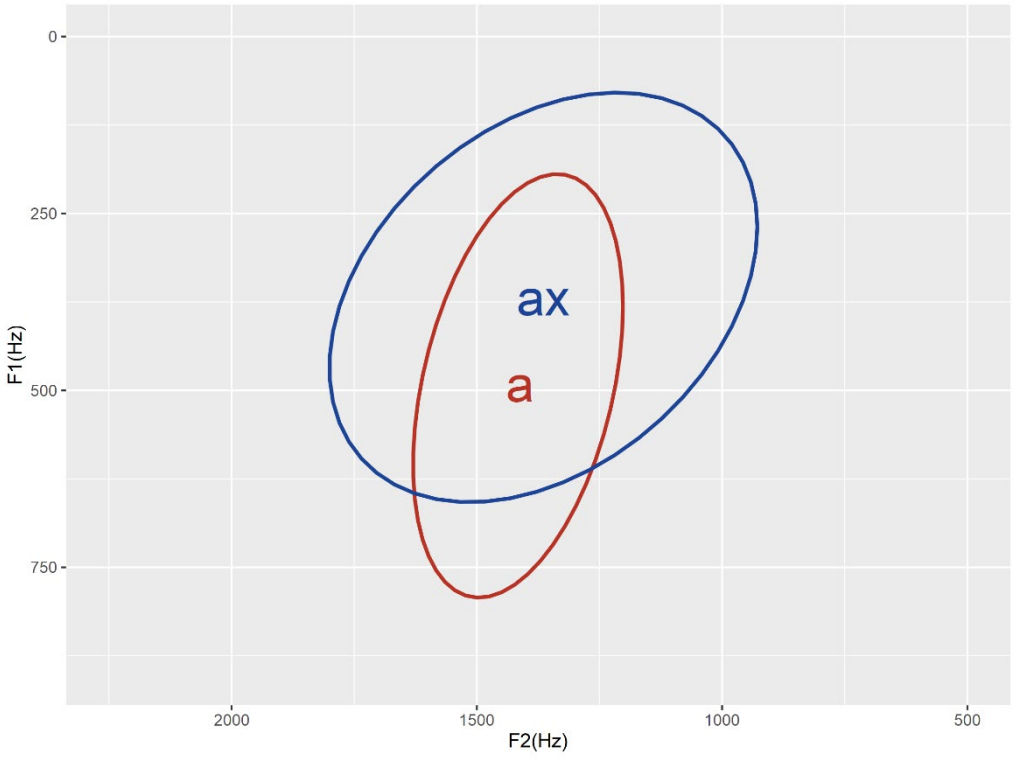

Figure 5-9: First and second frequency measurements at vowel midpoints for vowels that are represented by graphemes <a> and <ax> in the Kufo alphabet (Kafi & Mongash, 1998).

5.4 Discussion

Kufo has 18 contrastive vowel phonemes, which are short and long vowels of 9 contrastive vowel qualities. The vowel inventory exhibits an ATR-type contrast, but there is no evidence in the current data suggesting any kind of vowel harmony. The quality and length contrasts are supported by minimal pairs as well as first and second formant frequency and durational measurements.

Chapter 6 Tone

6.1 Introduction

This chapter focuses on Kufo tone. Section 6.2 presents the tonemes in Kufo. Section 6.3 presents evidence of tonal distinctions based on the results of an acoustic phonetic investigation of fundamental frequency. The examples presented in this chapter are included in Appendix E.

6.2 Tone phonology

Current data provides evidence for two lexically contrastive tonemes, a high level tone, which is marked with an acute accent á, and a low level tone, which is marked with a grave accent à. The tone-bearing unit in Kufo appears to be the syllable. Table 6-1 presents the tonemes in Kufo, and examples of tonal contrasts in disyllabic words are presented in Example 6-1.a compared to Example 6-1.b in Figure 6-1.a, as well as in Example 6-1.c compared to Example 6-1.d and in Figure 6-1.b. It is worth noting that tone contrasts have not yet been observed in monosyllabic words, which all appear to carry a high tone when elicited within a frame without a following long pause, and which carry a falling tone otherwise. Tonal minimal pairs are rare, and tone appears to have a low functional load both lexically and grammatically based on the data collected for the current project.

Table 6-1: Kufo tone inventory.

toneme	marking	allotone
high	á	falling (â), statement final
low	à	

(6-1)	a.	/ɲáːɾá/	[ɲáːɾá]	cousin SG
	b.	/ɲàːɾà/	[ɲàːɾà]	fences PL
	c.	/ʈàɓó/	[ʈàɓó]	kiss INF
	d.	/ʈáɓò/	[ʈáɓò]	broken

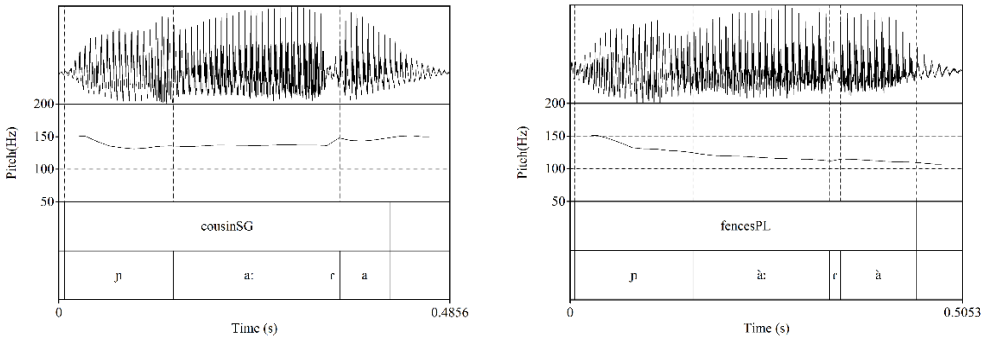

Figure 6-1.a: Spectrogram and pitch tracking showing examples of tonal contrast, high-high (left) vs. low-low (right).

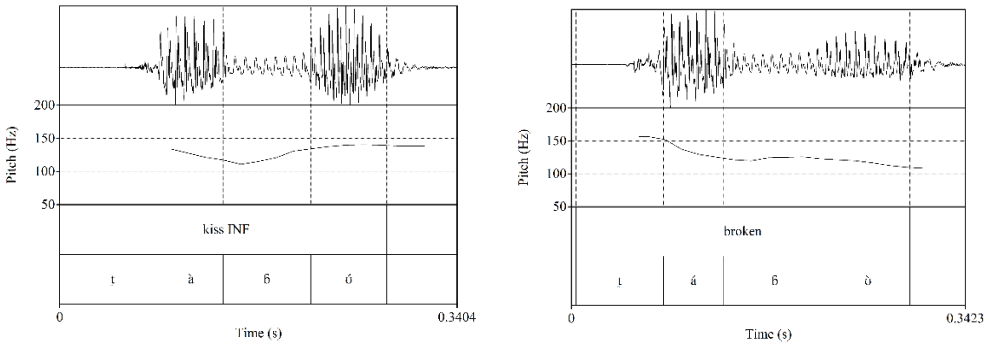

Figure 6-1.b: Spectrogram and pitch tracking showing examples of tonal contrast, high-low (left) vs. low-high (right).

The high level tone has a falling contour tone as its allotone, occurring at the ends of utterances. However, an auditory falling tone is observe in one lexeme, which is presented in Example 6-2 [6]and Figure 6-2. It is unclear why this arises,

[6] This example is also an exception to the usual realisation of /s/ as [ʃ, ʒ] before close and near-close front vowels.

but as it occurs on a long vowel, it is possible that there has been some kind of intervocalic elision leading between two vowels of the same quality and differing tones.

(6-2) /t̪î:sì/ [t̪î:zì] hay PL[20220506]

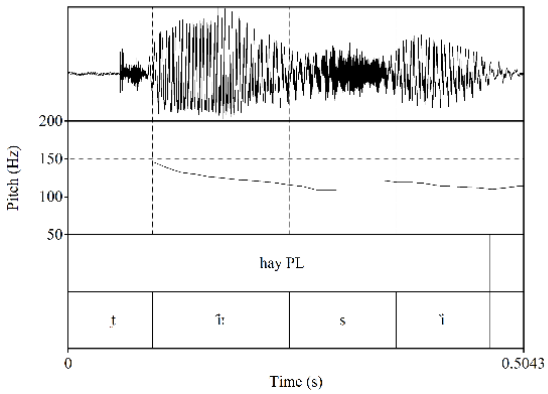

Figure 6-2: Spectrogram and pitch tracking showing the example of the auditory falling tone in the initial syllable of a disyllabic word.

In previous studies, tone is proposed to have grammatical functions in Kufo and the Kadu languages in general, such as distinguishing completive and incompletive aspects of verbs in Krongo (Reh, 1985). So far, no concrete evidence for grammatical uses of tone has been observed in the current study. Along with the segmental features, tonal features appear to be inseparable components of word stems, and are not altered for different tenses, aspects, and moods (TAM), or in processes like singularisation and pluralisation.

Examples of tonal patterns in verb conjugations are presented in Example set 6-3, where the high-low pattern in the infinitive form of the verb ‘buy’ (Example 6-3.a) remains unchanged throughout the TAM spectrum for first person

singular conjugations; the only difference between imperfective and perfective aspects is that the vowel in the initial syllable of the perfective form is lengthened compared to that in the perfective form, as can be seen in Example 6-3.b compared to Example 6-3.c.

(6-3)	a.	/t̪àná/	[t̪àná]	buy INF[20220714]
	b.	/nànáː/	[nànáː]	buy 1SG IPFV[20220714]
	c.	/nàːnáː/	[nàːnáː]	buy 1SG PFV[20220714]
	d.	/nàkàːnáː/	[nàgàːnáː]	buy 1SG PST[20220714]
	e.	/nàt̪ːáná/	[nàt̪ːáná]	buy 1SG FUT[20220714]
	f.	/nàt̪ːáːkànáː/	[nàt̪ːáːgànáː]	buy 1SG COND[20220714]

As is noted in Section 4.3, Kufo nouns can be marked as either singular or plural. Pluralisation is usually marked with a *nà-* prefix to the root form, whereas singularisation is general marked with a syllabic nasal or a syllable with a nasal coda in front of the stem. As can be seen in Example 6-4.a, Example 6-4.b, Example 6-4.c, and Example 6-4.d, in pluralisation, the tone in the *nà-* prefix is not affected by the tone in the stem, but the quality of the open central vowel in the prefix in some cases assimilates to the quality of the first vowel in the noun stem, as can be seen in Example 6-4.b and Example 6-4.c, and sometimes the vowel in the prefix is lengthened, as can be seen in Examples 6-4.c and Example 6-4.d. Similarly, in singularisation, the additional syllable, regardless of its structure, always carries a low tone, and is again not affected by the noun stem.

(6-4)	a.	/t̪ɔ̀t̪ːɔ́/	[t̪ɔ̀t̪ːɔ́]	2nd born female SG[20220704]

	/nàt̪ɔ̀t̪ːɔ́/	[nàd̪ɔ̀t̪ːɔ́]	2nd born female PL[20220704]
b.	/kɔ́sːɔ́/	[kɔ́sːɔ́]	mongoose SG[20220704]
	/nàkɔ́sːɔ́/	[nɔ̀gɔ́sːɔ́]	mongoose PL[20220704]
c.	/kìlì/	[kìlì]	African cane rat SG[20220704]
	/nàːkìlì/	[nɛ̀ːgìlì]	African cane rat PL[20220704]
d.	/fàɗà/	[fàɗà]	cave SG[20220704]
	/nàːfàɗà/	[nàːvàɗà]	cave PL[20220704]
e.	/fòlò/	[fòlò]	k.o. tree PL[20220704]
	/t̪ànfòlò/	[t̪ànvòlò]	k.o. tree SG[20220704]
f.	/ʈáːɾú/	[ʈáːɾú]	leaves PL[20221006]
	/ɳ̀ʈáːɾú/	[ɳ̀ɖáːɾú]	leaf SG[20221006]

In summary, tone appears to be an inseparable component of word stems, both for inflected forms of verbs and for number-marked nouns. Tone appears to be a part of the inflectional affixes such as /nà-/ as well, as the tones on these affixes do not appear to be affected by the tone in stems. Comparatively, the vowel quality in these affixes is often influenced by the vowel quality in the stem. While there is as yet no evidence for grammatical functions of tone in Kufo, it is also possible that this is due to the limitations of time and data for this study, and this area requires further exploration.

6.3 Acoustic phonetic evidence: tone

6.3.1 Materials

Based on the descriptive phonological data at the initial stage of the current study, Kufo has two contrastive tonemes, a high and a low level tone. The database which was designed to examine vowel quality and length, described in Section 5.3, was further coded with tones annotated at the syllable level. The falling tone, since it only occurs in the initial syllable of five occurrences of one lexical item, was excluded from this database. The tone database examines the fundamental frequency (f0) of 661 vowels of various qualities in either high-toned or low-toned syllables. The acoustic phonetic analysis of tone looks at the fundamental frequency across each vowel, measured at 5% intervals from 20% to 80%, to avoid pitch perturbations caused by preceding and following consonants.

6.3.2 Results

The results of fundamental frequency measurements are presented in Table 6-2 and Figure 6-3, respectively showing f0 means at vowel midpoints and the f0 measures at 5% intervals throughout the vowels. The mean fundamental frequency for the high tones at vowel mid points is 131Hz, and the mean fundamental frequency for the low tones at vowel mid points is 120Hz. The 11Hz difference, though quite small, corresponds with auditory impressions of pitch differences. The standard deviation is, however, larger than this difference, and is likely to be affected by the different vowel qualities in the dataset.

Table 6-2: Fundamental frequency measurements (Hz), at vowel midpoint.

tone	mean f0	standard deviation
high	131	31
low	120	30

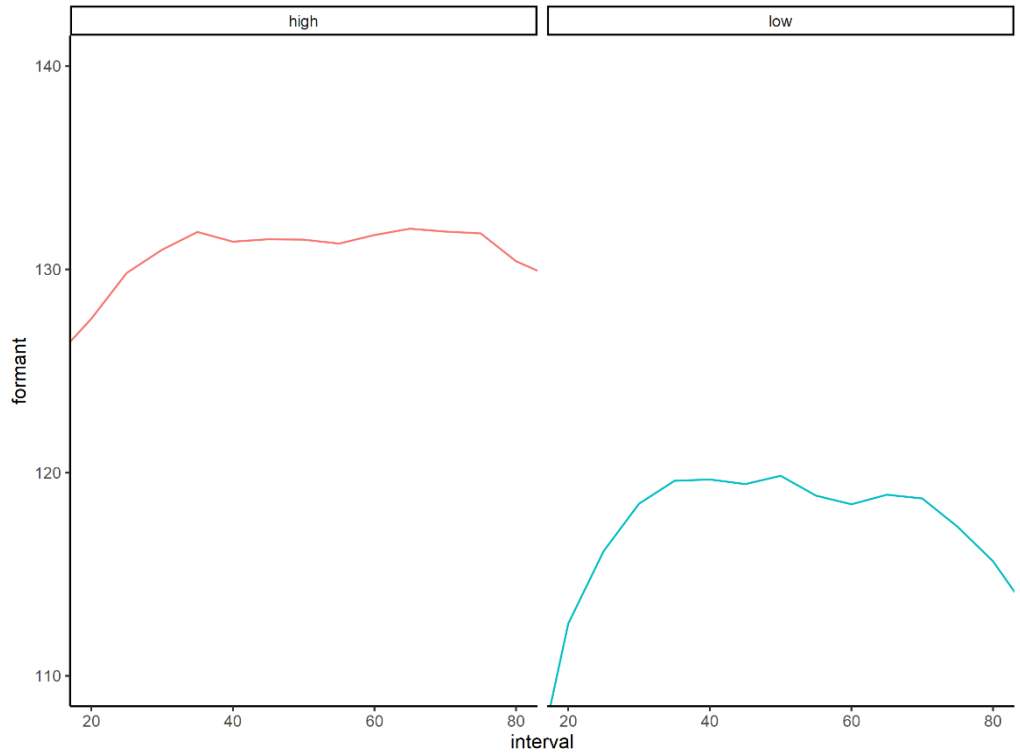

Figure 6-3: Fundamental frequency measurements, at 5% intervals.

6.4 Discussion

Kufo has two contrastive tones, a high level tone which has the falling tone as its allotone in statement final position, and a low level tone. The tone bearing unit appears to be the syllable.

Chapter 7 Discussion and Conclusion

7.1 Introduction

This chapter discusses the results of the current study. Section 7.2, 7.3 and 7.4 respectively focus on the consonants, the vowels, and the tones in Kufo. Section 7.5 presents the conclusions.

7.2 Consonants

In addressing Research Questions 1 and 2, this study has found evidence that Kufo has 30 contrastive consonant phonemes, including plosives, implosives, fricative, nasals, liquids, and glides, and they occur at various labial, coronal, and dorsal places of articulation (presented in Table 4-1). Regarding the places of articulation of Kufo consonants, the pulmonic plosives occur at bilabial, dental, retroflex, palatal, velar, and glottal places of articulation, the implosives occur at bilabial and alveolar places of articulation, the fricatives occur at labio-dental and alveolar places of articulation, the nasals occur at bilabial, alveolar, palatal, and velar places of articulation, the liquids, including a tap, a trill, and a lateral, occur at alveolar place of articulation, and the glides occur at labial-velar and palatal places of articulation. The places of articulation of anterior coronal plosives and labial fricatives, which are disputed in previous studies (Blench & Mongash, 2022; Dafalla, 2006; M. Hall & Hall, 2004; Kafi & Mongash, 1998; Reh, 1985; Schadeberg, 1994), are found to be dental for the plosives and labio-dental for the fricatives. The postalveolar fricatives, which are proposed as independent phonemes in many previous studies (Blench & Mongash, 2022; M. Hall & Hall, 2004; Kafi & Mongash, 1998; Reh, 1985), are found to be

allophones of the alveolar fricatives when neighbouring close or near-close front vowels, as is suggested by Schadeberg (1994). This allophonic process is possibly a dialectal difference in East Kufo, where Haroun comes from, and may not be present in other Kufo dialects. The only counterexample noted by Schadeberg (1994), *albɔssini*, is produced as /t̪àlɓɔ́sːìnì/ [t̪àlɓɔ́ʃːìnì] in the data collected for the present study. Most consonants that are reported only by Dafalla (2006), including the voiceless palatal fricative, the voiceless glottal fricative, and the palatal implosive, are not observed in the data collected for the present study; however, the postalveolar affricate is found in one lexical item only in the current data and is possibly caused by the influence of the Arab nomads.

Plosives and fricatives in Kufo exhibit interesting laryngeal, airstream, and length features. They appear to exhibit a length contrast, which interacts in complex ways with other consonant characteristics. The short plosives and fricatives are voiced between voiced segments, which are usually vowels but sometimes nasals as well, and otherwise voiceless, whereas the long plosives and fricatives remains voiceless regardless of the environment. The short plosives and fricatives could be analysed as 'lenis' consonants on the basis of their short durations accompanied by voicing, and also since some short consonants, for example the short palatal plosive /c/, has been found to be reduced as approximants in fluent speech. The long plosives and fricatives could be interpreted as 'fortis' consonants, on the basis of their long closure durations and consistent voiceless realisation. Consonant distinctions with similar kinds of patterns of voicing and duration characteristics elsewhere in the world, for example in Australian languages, have been described as 'lenis' vs. 'fortis'

(Butcher, 2004); this has also been proposed for some Bantu languages (Gerhardt, 1980), but not so much for languages of the Nilo-Saharan phylum. This contrast between 'fortis' and 'lenis' plosives and fricatives is supported by the durational measurements of the database, and this first exploration of the phonetics of consonant distinctions in a Kadu language has helped clarify the relationship between voicing and length, which has been a point of difference in many previous analyses. This also points to an interesting typological pattern which does not seem have been reported in related language varieties.

The long palatal stop and long implosives, which are noted as "neither voiced nor voiceless" by Schadeberg (1994), are well explained by the Kufo phonological description developed in this study and supported by acoustic phonetic evidence. The palatal stop is voiceless in word-initial position but is also found to be reduced to a voiced approximant in fluent speech, potentially explaining the impression that it is neither voiced nor voiceless, and the long implosives proposed by Schadeberg (1994) are shown to actually implosives following a glottal stop, a sequence that is first voiceless then voiced.

Regarding phonotactics, which is rarely discussed in previous studies, Kufo words appear to favour CV.CV and CV.CV.CV structures. Onset clusters exist but are limited to /kr/ and /kw/. Codas are rare and are restricted to bilabial, alveolar, and palatal nasals for Kufo words, though codas of other manners of articulation are found in Arabic loan words.

7.3 Vowels

In addressing Research Questions 1 and 3, this study has found supporting evidence that Kufo has 18 vowel phonemes which are long and short vowels of 9 contrastive qualities, presented in Table 5-1. The Kufo vowel phonemes include the long and short unrounded close front vowels /iː, i/, the long and short unrounded near-close front vowels /ɪː, ɪ/, the long and short unrounded close-mid front vowels /eː, e/, the long and short unrounded open-mid front vowels /ɛː, ɛ/, the long and short open central vowels /aː, a/, the long and short rounded open-mid back vowels /ɔː, ɔ/, the long and short rounded close-mid back vowels /oː, o/, the long and short rounded near-close back vowels /ʊː, ʊ/, and the long and short close back vowels /uː, u/. The contrastive vowel qualities are supported by phonological evidence as well as the measurements of the vowel database. The analysis of 9 contrastive vowel qualities well explains the dispute of a 7, 9, or 10 vowel system in previous studies (Blench & Mongash, 2022; Dafalla, 2006; M. Hall & Hall, 2004; Kafi & Mongash, 1998; Reh, 1985; Schadeberg, 1994), and is backed up by both descriptive phonological and acoustic phonetic data. Specifically for /ɪ/ compared to /e/ and /ʊ/ compared to /o/, the vowel qualities that are notoriously difficult to distinguish and are considered as allophones by Schadeberg (1994) and Reh (1985), minimal pairs are presented in Section 5.2 showing that they are contrastive in the present study. The first formant frequency differences align with the crosslinguistic tendency for ATR distinctions (Casali, 2008). The Kufo vowel qualities appear to have an ATR-type contrast and four [+/-ATR] pairs (/i, ɪ/, /e, ɛ/, /o, ɔ/, /u, ʊ/) based on auditory impressions and F1 measurements in the database, which echoes with what is

proposed by previous studies. Nevertheless, despite the fact that the ATR feature generally cooccurs with vowel harmony (Casali, 2008), it is yet unclear whether Kufo exhibit vowel harmony based on the Advanced Tongue Root contrast. Kufo does not appear to have restrictions on which kinds of vowels can co-occur within a word, and there is no evidence for an ATR-type harmony. While there is as yet no morphophonological evidence for this, the acoustic measurement results in this study offer a reference point for more closely examining the [+ATR] or [-ATR] status of vowels in other data, allowing for closer investigation of any possible vowel harmony. Moreover, the measurements of first and second formant frequencies at vowel midpoints for /a/ and /aː/ in the vowel database suggest that the short open central vowel /a/ appears to be more centralised and have a wider range of distribution than its long counterpart /aː/, which indicates that the centralised /a/ has likely been perceived as [ə] or /ə/ in previous studies. The length contrast, which was unclear and rarely discussed in detail in previous studies (Blench & Mongash, 2022; Dafalla, 2006; M. Hall & Hall, 2004; Kafi & Mongash, 1998; Reh, 1985; Schadeberg, 1994), is supported by both phonological observations and acoustic phonetic evidence in the current study. The duration of the long vowels is approximately twice as long as for the short vowels.

Regarding the central vowels, the short mid central vowel [ə] appears to be an allophone of the short open central vowel /a/ in multisyllabic words, and there is no evidence suggesting that [ə] is an independent phoneme in the present study, as was previous proposed by Dafalla (2006) and Blench & Mongash (2022). This is supported by the database examining the the vowel qualities corresponding to

the graphemes <a> and <ax> in the alphabet book (Kafi & Mongash, 1998), where <ax> appeared to correspond to slightly centralised open central vowels but otherwise not have a distinct quality to <a>.

7.4 Tone

In addressing Research Questions 1 and 4, this study finds that Kufo has a high level tone and a low level tone, respectively marked with an acute accent and a grave accent. This tonal contrast is supported by minimal pairs in descriptive phonological data as well as the measurements of fundamental frequency in the database, though this requires further investigation with data controlled for vowel quality and consonantal influences. Kufo tone appears to be an inseparable component of the stems and is not altered during verb conjugations and noun singularisation or pluralisation. In future work, pitch conditioning and intonation will be particularly worth studying. Since Kufo only has two tones, it is expected to have a rich range of pitch realisations of these tones, which have not been examined in the current study. Intonation is beyond the scope of the current project.

While much work still remains to be done on Kufo tone, this study aids preparation for future studies on tonal patterns in the Kufo language. Though the Kadu languages are often hypothesised as tonal, their tone systems have never been systematically studied. The findings on contrastive vowel quality and length allow these characteristics to be controlled for in analyses focusing on tone, in order for the prosodic system of Kufo to be better understood.

7.5 Conclusion

This study significantly extends available knowledge on Kufo linguistic patterns. The proposed consonant, vowel, and tone inventory and exploratory acoustic phonetic results lay the groudwork for future studies on the Kufo sound system. For future research, it will be important to involve more Kufo speakers in the project, to better understand patterns across speakers, and potential variation. It will also be important to expand the available lexical data. As more lexical data for the language becomes available, it will be possible to develop more comprehensive databases for quantitatively studying aspects of the Kufo sound system, with sufficient data for statistical investigations to also be undertaken. Examining the phonetics and phonology of related language varieties would also be crucial for comparative studies.

The present findings also provide insights into the vowel systems of the Kadu language family more generally, whose phonemic inventories have not yet been comprehensively studied and phonetically examined. The languages of the Nuba Mountains in Sudan are extremely diverse but very understudied, and in some cases highly endangered, and there is much still to learn about the linguistic structures and relationships in this region. More broadly, the present study contributes to the phonological studies of African languages based on phonetic data. While there are rich descriptions on interesting phonological phenomena for African languages, phonetic data is rarely brought to bear on discussions of African phonological systems.

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Appendices

Appendix A: Abbreviations and Glosses.

1	first person
2	second person
3	third person
ATR	Advanced Tongue Root
C	consonant
COND	conditional
EXCL	exclusive
F	feminine
f0	fundamental frequency
F1	first formant frequency
F2	second formant frequency
FUT	future
H	high tone
Hz	hertz
IMP	imperative
INCL	inclusive
INF	infinitive
IPFV	imperfective
L	low tone
M	masculine

PFV	perfective
POSS	possessive
SG	singular
V	vowel

Appendix B: Wordlist for the plosive database.

Source marking: [20220811].

Corresponding audio file in the PARADISEC collection KCP2:

KCP2-20220811_1_Consonants2-h5.wav.

phoneme	phone	translation	VOT
/náp:á/	[náp:á]	fathers PL	vot_p
/t̪òpé/	[t̪òb:é]	red	vot_n
/t̪àɓú/	[t̪àɓú]	suck INF	vot_n
/t̪àpá/	[t̪àb:á]	hit INF	vot_n
/t̪àɓá/	[t̪àɓá]	tap INF	vot_n
/kíɓɛ̀/	[kíɓɛ̀]	goat SG	vot_n
/t̪àɓó/	[t̪àɓó]	kiss INF	vot_n
/nòɓò/	[nòɓò]	place SG	vot_n
/kóɓá/	[kóɓá]	bone SG	vot_n
/t̪òt̪:ó/	[t̪òt̪:ó]	spit INF	vot_p
/t̪òt̪:ò/	[t̪òt̪:ò]	grind INF	vot_p
/t̪ít̪:í/	[t̪ít̪:í]	k.o. bird SG	vot_p
/mòt̪:ó/	[mòt̪:ó]	horse SG	vot_p
/mùt̪ù/	[mùd̪ù]	winewaste PL	vot_n
/t̪ídĩ/	[t̪ídĩ]	see INF	vot_n
/mídĩ/	[mídĩ]	smiley	vot_n
/t̪ɛ̀:t̪é/	[t̪ɛ̀:d̪é]	kill INF	vot_n

/kát̪ó:/	[kád̪ó:]	people	vot_n
/t̪à:t̪à/	[t̪à:d̪à]	grandmother SG	vot_n
/mídĭ/	[mídĭ]	person	vot_n
/t̪àt̪:á/	[t̪àt̪:á]	cut INF	vot_p
/t̪àt̪á/	[t̪àd̪á]	skin INF	vot_n
/t̪ì̪cá/	[t̪ì̪ɟá]	milk INF	vot_n
/t̪èca/	[t̪èɟá]	awake INF	vot_n
/kɔ̀k:ɔ́/	[kɔ̀k:ɔ́]	hibiscus	vot_p
/t̪ò̪k:ò̪/	[t̪ò̪k:ò̪]	write INF	vot_p
/t̪ùk:ù/	[t̪ùk:ù]	drive INF	vot_p
/t̪úk:ú/	[t̪úk:ú]	rotten	vot_p
/t̪ɔ̀k:ɔ̀/	[t̪ɔ̀k:ɔ̀]	hiccough INF	vot_p
/t̪ì̪k:á/	[t̪ì̪k:â]	tomorrow	vot_p
/t̪ì̪k:í/	[t̪ì̪k:í]	say INF	vot_p
/t̪ò̪k:ò/	[t̪ò̪k:ò]	scrape INF	vot_p
/t̪ɔ̀k:ɔ̀/	[t̪ɔ̀k:ɔ̀]	scratch INF	vot_p
/kɔ̀:kɔ́/	[kɔ̀:gɔ́]	insects PL	vot_n
/kì:kà/	[kì:gà]	where	vot_n
/lá:ká/	[lá:gá]	saliva	vot_n

Appendix C: Wordlist for the vowel database and the tone database.

Source marking: [20220506].

Corresponding audio file in the PARADISEC collection KCP2:

KCP2-20220506_1_Wordlist1-h6nt3.wav.

phoneme	phone	translation
/kìkːí/	[kìkːí]	4th born male SG
/ʈ̪ìdĭ/	[ʈ̪ìdĭ]	see INF
/kílí/	[kílí]	k.o. rat SG
/kísːí/	[kíʃːí]	guts PL
/kísí/	[kíʒí]	rocks PL
/fiːní/	[fiːní]	road SG
/líːlí/	[líːlí]	unbearable heat
/ʈ̪ìmì/	[ʈ̪ìmì]	rain PL
/ʈ̪ìmí/	[ʈ̪ìmí]	sit INF
/ʈ̪îːsì/	/ʈ̪îːzì/	hay PL
/ʈ̪íːlé/	[ʈ̪íːlé]	forest SG
/kìkːí/	[kìkːí]	4th born female SG
/mìdĭ/	[mìdĭ]	tie IMP
/ɓìlːí/	[ɓìlːí]	s.th. woven SG
/ʈ̪ìʔdĭ/	[ʈ̪ìʔdĭ]	love INF
/kìɾì/	[kìɾì]	shin SG
/líːlí/	[líːlí]	money

/mìdì/	[mìdì]	person SG
/sìkà/	[ʃìgà]	farm SG
/sí:ká/	[ʃí:gá]	milk PL
/cé:né/	[ɟé:né]	bright, clean IMP
/ɲé:ké/	[ɲé:gé]	mosquitoes PL
/kɛ̀:ɾɛ̀/	[kɛ̀:ɾɛ̀]	blade SG
/ʈɛ̀:ʈɛ́/	[ʈɛ̀:ɖɛ́]	kill INF
/ʈé:ʈé/	[ʈé:ɖɛ́]	pour INF
/lɛ́:lɛ́/	[lɛ́:lɛ́]	weed IMP
/ʈɛ̀:sɛ́/	[ʈɛ̀:zɛ́]	filter SG
/mɛ́:kɛ́/	[mɛ́:gɛ́]	ratel SG
/kásá/	[kázá]	broom SG
/lá:ká/	[lá:gá]	saliva PL
/fádà/	[fádà]	cave SG
/ɓàkà/	[ɓàgà]	mad person SG
/sàɾà/	[sàɾà]	pot SG
/là:là/	[là:là]	spicy
/ɓàlà/	[ɓàlà]	play IMP
/ʈàwɛ̀/	[ʈàwɛ̀]	drink INF
/kɔ́:ɾɔ́/	[kɔ́:ɾɔ́]	addax SG
/kɔ́lɔ́/	[kɔ́lɔ́]	fire hawk SG
/kɔ́:lɔ́/	[kɔ́:lɔ́]	valley SG
/dɔ̃lɔ́/	[dɔ̃lɔ́]	hunting club SG

/sɔ̀lɔ̀/	[sɔ̀lɔ̀]	fish spear SG
/ɓɔ̀kːɔ̀/	[ɓɔ̀kːɔ̀]	k.o. rat SG
/lɔ̀fò/	[lɔ̀fò]	mudded place SG
/kòkːó/	[kòkːó]	hibiscus SG
/kòːkó/	[kòːgó]	insect SG
/fòlò/	[fòlò]	k.o. tree SG
/fòlò/	[fòlò]	wasp PL
/fòɗò/	[fòɗò]	esophagus SG
/ʈ̪óːɾó/	[ʈ̪óːɾó]	bull SG
/ʈ̪óːnó/	[ʈ̪óːnó]	leather
/fòɾɔ́/	[fòɾɔ́]	snake trail SG
/fóːɗǒ/	[fóːɗǒ]	dream SG
/mòʈ̪ːó/	[mòʈ̪ːó]	horse SG
/ʈ̪òlːó/	[ʈ̪òlːó]	shadow SG
/kúsːó/	[kúsːó]	mongoose SG
/nòɓò/	[nòɓò]	place/time SG
/fòɗǒ/	[fòɗǒ]	soil PL
/ʈ̪òfːùː/	[ʈ̪òfːùː]	hessian SG
/ʈ̪ólːí/	[ʈ̪ólːí]	flowers PL
/zúkú/	[zúgú]	hessian vine SG
/ɓúsú/	[ɓúzú]	smallpox
/múɗǔ/	[múɗǔ]	wine waste PL
/músò/	[múzò]	k.o. plant SG

/mùsó/	[mùzó]	flour PL
/fùló/	[fùló]	gourd SG

Appendix D: Wordlist for the <a> vs. <ax> database.

Corresponding audio file in the PARADISEC collection KCP2:

KCP2-20220511_4_Vowels8-h6nt3.wav

orthography	phoneme	phone	English translation
-	/kàkːá/	[kàkːá]	1st born female SG
-	/káːsá/	[káːzá]	broom PL
-	/ʈàpá/	[ʈàbːá]	hit INF
-	/ɓàkà/	[ɓàgà]	mad person SG
-	/sàɾà/	[sàɾà]	pot SG
-	/làːlà/	[làːlà]	spicy
<ndaxrfix>	-	-	ball SG
<fax'dax>	-	-	cave SG
<taxwe>	-	-	drink INF
<axmzax>	-	-	lizard SG
<rax>	-	-	panther SG
<taxfaxdax>	-	-	return INF

Appendix E: Examples in Chapter 4, Chapter 5, and Chapter 6.

Source and corresponding audio files in the PARADISEC collection KCP2:

[20220704]: KCP2-20220704_Wordlist3-h6nt3.wav

[20220714]: KCP2-20220714_Verbs4-h5.wav

[20220811]: KCP2-20220811_Consonants2-h5.wav

[20220818_3]: KCP2-20220818_Consonants3-wordlist3_h5.wav

[20220824]: KCP2-20220824_Consonants4-wordlist_h5.wav

[20220908_1]: KCP2-20220908_KufoCustoms2-wordlist1_h5.wav

[20220908_2]: KCP2-20220908_KufoCustoms2-wordlist2_h5.wav

[20220908_5]: KCP2-20220908_KufoCustoms2-wordlist5_h5.wav

[20220908_6]: KCP2-20220908_KufoCustoms2-wordlist6_h5.wav

[20220915_1]: KCP2-20220915_KufoCustoms3-wordlist1_h5.wav

[20220915_2]: KCP2-20220915_KufoCustoms3-wordlist2_h5.wav

[20220915_3]: KCP2-20220915_KufoCustoms3-wordlist3_h5.wav

[20220915_4]: KCP2-20220915_KufoCustoms3-wordlist4_h5.wav

[20221006]: KCP2-20221006_KufoCustoms6-wordlist_h5.wav

[20221014]: KCP2-20221014_Revisitation3-h5.wav

[20221021]: KCP2-20221021_KufoCustoms7-h5.wav

phoneme	phone	translation	source
/kòkːó/	[kòkːó]	1st born male SG	20220704
/nòkòkːó/	[nògòkːó]	1st born male PL	20220704
/kìkːí/	[kìkːí]	4th born male SG	20220704
/nɛ̀kìkːí/	[nɛ̀kìkːí]	4th born male PL	20220704
/kàkːá/	[kàkːá]	1st born female SG	20220704
/nàkàkːá/	[nàgàkːá]	1st born female PL	20220704
/t̪ɔ̀t̪ːɔ́/	[t̪ɔ̀t̪ːɔ́]	2nd born female SG	20220704
/nàt̪ɔ̀t̪ːɔ́/	[nàd̪ɔ̀t̪ːɔ́]	2nd born female PL	20220704
/kìkːí/	[kìkːí]	4th born female SG	20220704
/nɛ̀kìkːí/	[nɛ̀kìkːí]	4th born female PL	20220704
/kàkːá/	[kàkːá]	mad person SG	20220704
/nàkàkːá/	[nàgàkːá]	mad person PL	20220704
/kɔ̀ːɾɔ̀/	[kɔ̀ːɾɔ̀]	addax SG	20220704
/nɔ̀kɔ̀ːɾɔ̀/	[nɔ̀gɔ̀ːɾɔ̀]	addax PL	20220704
/kìlì/	[kìlì]	African cane rat SG	20220704
/nɛ̀ːkìlì/	[nɛ̀ːgìlì]	African cane rat PL	20220704
/fòlò/	[fòlò]	k.o. tree PL	20220704
/t̪ànfòlò/	[t̪ànvòlò]	k.o. tree SG	20220704
/kósːó/	[kósːó]	mongoose SG	20220704
/nòkósːó/	[nògósːó]	mongoose PL	20220704
/kɛ́ːɾɛ́/	[kɛ́ːɾɛ́]	razor SG	20220704
/nàkɛ́ːɾɛ́/	[nàgɛ́ːɾɛ́]	razor PL	20220704

/ká:sá/	[ká:zá]	broom PL	20220704
/tànká:sá/	[tàngá:zá]	broom SG	20220704
/ʈó:ɾó/	[ʈó:ɾó]	bull SG	20220704
/nàʈó:ɾó/	[nàɖó:ɾó]	bull PL	20220704
/kúʈó/	[kúɖó]	butt PL	20220704
/náŋkúʈó/	[náŋgúɖó]	butt SG	20220704
/fàdà/	[fàdà]	cave SG	20220704
/nà:fàdà/	[nà:vàdà]	cave PL	20220704
/á nàʈ:áná/	[á nàʈ:áná]	I buy 1SG FUT	20220714
/ànʈ:áná/	[ànʈ:áná]	I buy 1SG FUT	20220714
/ʈàná/	[ʈàná]	buy INF	20220714
/nàná/	[nàná]	buy 1SG IPFV	20220714
/nà:ná/	[nà:ná]	buy 1SG PFV	20220714
/nàkà:ná/	[nàgà:ná]	buy 1SG PST	20220714
/nàʈ:áná/	[nàʈ:áná]	buy 1SG FUT	20220714
/nàʈ:á:kàná/	[nàʈ:á:gàná]	buy 1SG COND	20220714
/kàʔɓá/	[kàʔɓá]	large thresher SG	20220811
/kàʔɓɛ́/	[kàʔɓɛ́]	small thresher SG	20220811
/ʈòʔɓò/	[ʈòʔɓò]	close INF	20220811
/mòʔdò/	[mòʔdò]	k.o. ceremony	20220811
/ʈìʔdì/	[ʈìʔdì]	delicious	20220811
/ʈòʔdŏ/	[ʈòʔdŏ]	dirt	20220811
/ʈòʔdò/	[ʈòʔdò]	fold INF	20220811

/ʈìʔdǐ/	[ʈìʔdǐ]	love INF	20220811
/ɲá:ɾá/	[ɲá:ɾá]	female cousin SG	20220818_2
/ɲà:ɾà/	[ɲà:ɾà]	fences PL	20220818_2
/ʈà:mà/	[ʈà:mà]	lost	20220818_3
/ʈànáˊ/	[ʈànáˊ]	buy INF	20220818_3
/ʈàn:à/	[ʈàn:à]	stay INF	20220818_3
/ʈàf:á/	[ʈàf:âˊ]	crawl INF	20220824
/ʈòfòlò/	[ʈòvòlò]	blow INF	20220824
/ʈòf:òlóˊ/	[ʈòf:òlóˊ]	swell INF	20220824
/ʈàfáˊ/	[ʈàváˊ]	have INF	20220824
/fáˊ/	[váˊ]	like PREP	20220824
/fáˊ/	[fâˊ]	tree SG	20220824
/ʈás:è/	[ʈás:è]	k.o. tattoo SG	20220824
/kís:í/	[kíʃ:í]	guts PL	20220824
/kìsì/	[kìʒì]	rocks PL	20220824
/kìsì/	[kìʃì]	rocks PL	20220824
/sìkà/	[ʃìgà]	farm SG	20220824
/síkɛ́:nɛ́/	[ʒígɛ́:nɛ́]	farms PL	20220824
/nàsíkɛ́:nɛ́/	[nàʒígɛ́:nɛ́]	farms PL	20220824
/ʈàɾáˊ/	[ʈàɾáˊ]	collect INF	20220824
/ʈàɾà/	[ʈàɾà]	dam SG	20220824
/ʈá:ɾáˊ/	[ʈá:ɾáˊ]	wildness	20220824
/ʈàráˊ/	[ʈàráˊ]	care INF	20220824

/ʈà:lá/	[ʈà:lá]	separate INF	20220824
/ʈàl:á/	[ʈàl:á]	stingy	20220824
/ʈáwá/	[ʈáwá]	dew PL	20220824
/ʈàw:ánɛ́/	[ʈàw:ánɛ́]	go INF	20220824
/ájá/	[ájá]	grass PL	20220824
/áj:à/	[áj:à]	mother SG	20220824
/ʈàdɛ̀/	[ʈàdɛ̀]	come INF	20220908_1
/ʈàl:ù/	[ʈàl:ù]	nice	20220908_2
/ʈàl::ù/	[ʈàl::ù]	nice INT	20220908_2
/fáŋá/	[fáŋá]	shed SG	20220908_5
/ɓáŋá/	[ɓáŋá]	aardvark SG	20220908_5
/ɓɔ́s:à/	[ɓɔ́ʈʃà]	everyday	20220908_6
/kòrì/	[kòrì]	food	20220915_1
/ʈàkòrì/	[ʈàgòrì]	eat INF	20220915_1
/kòrì/	[gòrì]	eat IMP	20220915_1
/áʔá nàkòrì/	[áʔá nàgòrì]	I eat.	20220915_1
/ʈàk:òrì/	[ʈàk:òrì]	sharp	20220915_1
/kúlɓá mànòk:òrì/	[kúlɓá mànòk:òrì]	Knife is sharp.	20220915_1
/dɔ̃lɔ́/	[dɔ̃lɔ́]	k.o. stick SG	20220915_2
/ná:dɔ̃lɔ́/	[ná:dɔ̃lɔ́]	k.o. sticks PL	20220915_2
/ʈɔ́lɔ́/	[ʈɔ́lɔ́]	container SG	20220915_2
/ná:ʈɔ́lɔ́/	[ná:ɖɔ́lɔ́]	containers PL	20220915_2
/ʈàcɛ́:nɛ́/	[ʈàɟɛ́:nɛ́]	wake up INF	20220915_4

/cɛ́ːnɛ́/	[cɛ́ːnɛ́]	wake up IMP	20220915_4
/ⱡùkːù/	[ⱡùkːù]	rotten	20221006
/ⱡòkːò/	[ⱡòkːò]	write INF	20221006
/ⱡòⱡːó/	[ⱡòⱡːó]	spit INF	20221006
/ⱡòⱡːò/	[ⱡòⱡːò]	grind INF	20221006
/ⱡìŋːà/	[ⱡìŋːà]	wind	20221006
/ⱡìŋá/	[ⱡìŋá]	smell INF	20221006
/ɬáːɾú/	[ɬáːɾú]	leaves PL	20221006
/ɳɬáːɾú/	[ɳɖáːɾú]	leaf SG	20221006
/dǐ mɛ̀ːmɛ́ àsːíʔɲà/	[dǐ mɛ̀ːmɛ́ àʃːíʔɲà]	My house is small.	20221006
/dǐ mɛ̀ːmɛ́ àsːíʔːɲà/	[dǐ mɛ̀ːmɛ́ àʃːíʔːɲà]	My house is very small.	20221006
/dǐ mɛ̀ːmɛ́ àɓòkːɛ́/	[dǐ mɛ̀ːmɛ́ àɓòkːɛ̂]	My house is big.	20221006
/dǐ mɛ̀ːmɛ́ àɓòkːːɛ́/	[dǐ mɛ̀ːmɛ́ àɓòʔkːːɛ̂]	My house is very big.	20221006
/ɲí nàsíkálà/	[ɲí nàʒígálà]	The snake is long.	20221006
/ɲí nàsíkáːlà/	[ɲí nàʒígáːlà]	The snake is very long.	20221006
/fá ɛ́ŋgɛ́ káɬà/	[fá ɛ́ŋgɛ́ káɖà]	The tree is ahead.	20221006
/fá ɛ́ŋgɛ́ káɬːà/	[fá ɛ́ŋgɛ́ káɬːà]	The tree is very ahead.	20221006
/ɓóɲú áɬáfàlà/	/ɓóɲú áɖáfàlà/	The ground is flat.	20221006

/ɓóŋú á:ʈáf:àlà/	/ɓóŋú á:ɖáf:àlà/	The ground is very flat.	20221006
/ʈúk:ù/	[ʈúk:ù]	drive INF	20221006
/ʈók:ò/	[ʈók:ò]	hiccough INF	20221006
/páʔjá/	[páʔjá]	all	20221006
/ʈàpá:ná/	[ʈàb:á:ná]	hit INF	20221006
/pá:ná/	[b:á:nâ]	hit IMP	20221006
/ʈàɓá:ná/	[ʈàɓá:ná]	pass INF	20221006
/ɓá:ná/	[ɓá:ná]	pass IMP	20221006
/mìɗĩŋí/	[mìɗĩŋí]	jungle cat SG	20221006
/mìʈíŋí/	[mìɖíŋí]	stars PL	20221006
/ʈàɓálà/	[ʈàɓálà]	play INF	20221006
/ʈàɓàlá/	[ʈàɓàlá]	change INF	20221006
/ʈáɓò/	[ʈáɓò]	broken	20221006
/ʈàɓʊ́/	[ʈàɓʊ́]	kiss INF	20221006
/á nàkɛ́:nɛ́ cɛ́:nɛ́ kú:f:ò/	[á nàgɛ́:nɛ́ ɟɛ́:nɛ́ kú:f:ò]	I was born in Kufo.	20221006
/ʈàlɓɔ́:sìnì/	[ʈàlɓɔ́:ʒìnì]	night	20221014
/ʈàlɓɔ́:sìnì/	[ʈàlɓɔ́:zìnì]	night [M]	20221014
/ìsá:ná/	[ìʒá:ná]	chop IMP	20221014
/sá:ná/	[zá:ná]	chop IMP [M]	20221014
/káʈʊ́:/	[káɖʊ́:]	people	20221014
/ʈòf:ù:/	[ʈòf:ù:]	hessian	20221014

/ʈíkó/	[ʈígó]	smoke	20221014
/ò:tó/	[ò:ɖó]	poop	20221014
/íjé/	[íjé]	seeds PL	20221014
/ɾíjé/	[ɾíjé]	brother SG	20221014
/nàkìɾíjé/	[nàgìɾíjé]	brother PL	20221014
/súlè/	[súlè]	eggs PL	20221014
/ʈánsúlè/	[ʈánzúlè]	egg SG	20221014
/àʔà/	[àʔà]	1SG	20221014
/màŋà/	[màŋà]	POSS 1PL.INCL	20221014
/má:ká/	[má:gá]	POSS 2PL	20221014
/kɾísì/	[kɾíʃì]	deer PL	20221014
/kɾá:ɲ/	[kɾá:ɲ]	hyena SG	20221014
/kɛ́:ɾú/	[kɛ́:ɾú]	porcupines PL	20221014
/m̩ʈàkɛ́:ɾú/	[m̩ʈàgɛ́:ɾú]	porcupine SG	20221014
/wí/	[wí]	birds PL	20221014
/ŋ̩ʈúwí/	[ŋ̩ɖúwí]	bird SG	20221014
/ʈìmí/	[ʈìmí]	sit INF	20221014
/ʈà:má/	[ʈà:má]	reply INF	20221014
/ʈà:mà/	[ʈà:mà]	lost	20221014
/mòt:ó/	[mòt:ó]	horse SG	20221014
/nàkòt:ó/	[nàgòt:ó]	horses PL	20221014
/kàɾkàɾí:p/	/kàɾgàɾí:b/	scraper	20221014

/ànàcùlá:ká/	/ànàɟùlá:ká/	may peace be upon you	20221014
/ànàcùlá:ká/	/ànàjùlá:ká/	may peace be upon you	20221014
/fá/	[fâ]	tree SG	20221021
/ná:fá/	[ná:vá]	trees PL	20221021
/sólɛ́/	[sólɛ́]	eggs PL	20221021
/ʈòɳsólɛ́/	[ʈòɳzólɛ́]	egg SG	20221021
/kàcàm/	[kàɟàm]	trap	20221021
/nùs/	[nùs]	half [Arabic]	20221021
/ní:sò/	[ní:zò]	hands PL	20221021
/kàràkàn/	[kàɾəgàn]	jaundice	20221021
/máŋà/	[máŋà]	POSS 1PL.INCL	20221021
/má:ká/	[má:gá]	POSS 2PL	20221021
/ŋò/	[ŋò]	1PL.EXCL	20221021
/nàkáŋkàsàlà/	[nàgáŋgəzàlà]	priests PL	20221021
/kùcù:ɾ/	[kùɟù:ɾ]	healing	20221021
/wá:nɛ̀/	[wá:nɛ̀]	go IMP	20221021
/jùkì/	[jùgì]	wife SG	20221021
/ʈàsá:ná/	[ʈàzá:ná]	chop INF	20221021
/ʈàsànà/	[ʈàzànà]	spray INF	20221021
/ɲɛ́/	[ɲɛ́]	sister SG	20221021
/ɲɛ̀/	[ɲɛ̀]	entrance SG	20221021

/ɛ̀p/	[ɛ̀p]	taboo [Arabic]	20221021
/lístʊ̀k/	[lísdʊ̀k]	rubber [Arabic]	20221021
/lɛ́flì/	[lɛ́flì]	pepper [Arabic]	20221021
/mɔ̀z/	[mɔ̀z]	banana [Arabic]	20221021
/hìpl/	[hìpl]	needle [Arabic]	20221021
/kɛ̀ɾkí/	[kɛ̀ɾgí]	bile PL	20221021
/tʊ̀nkɛ̀ɾkí/	[tʊ̀ngɛ̀ɾgí]	bile SG	20221021
/mìdĩŋí/	[mìdĩŋí]	stars PL	20221021
/tʊ̀mdĩŋí/	[tʊ̀mdĩŋí]	star SG	20221021
/úŋkú/	[úŋgú]	hyena SG	20221021
/kwɛ́/	[kwɛ́]	axe SG	20221021